MAY 1954

Power Engineering

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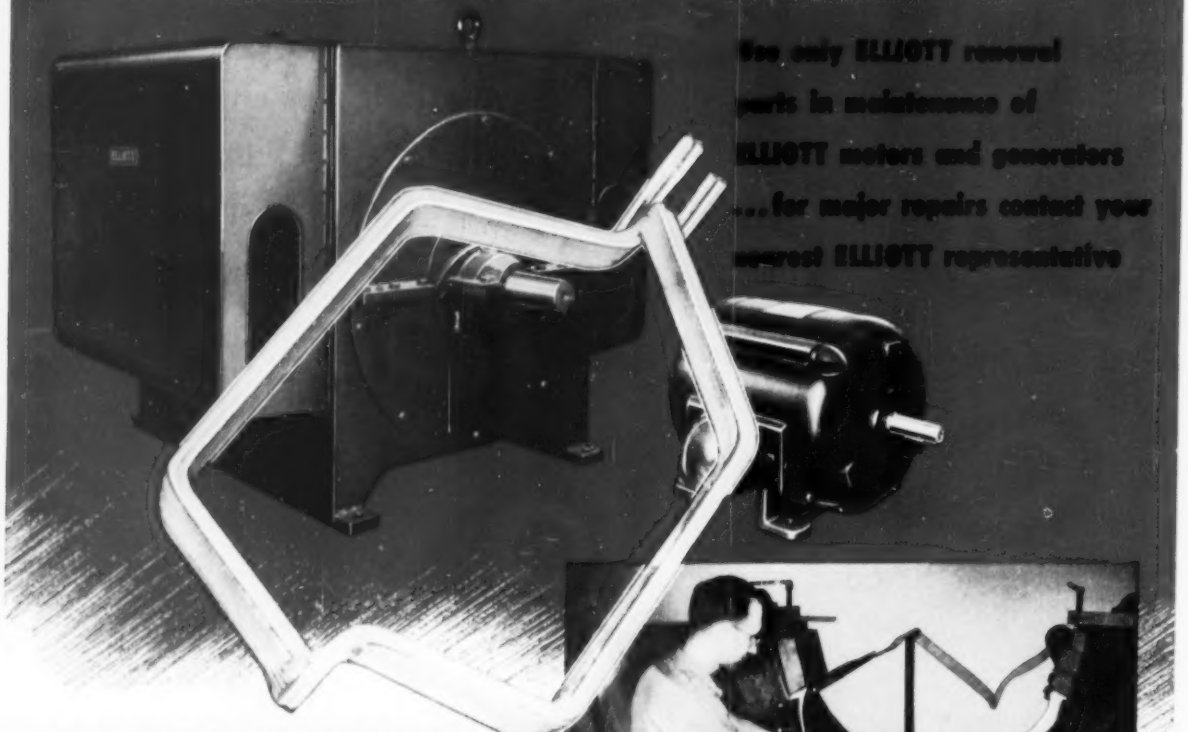
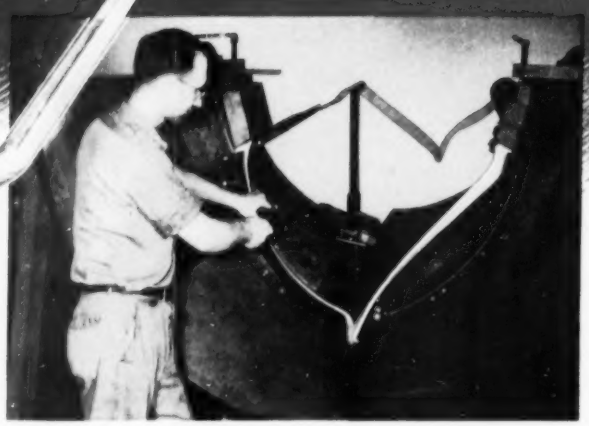
Use only ELLIOTT renewal parts in maintenance of ELLIOTT motors and generators ...for major repairs contact your nearest ELLIOTT representative





A REPLACEMENT COIL THAT'S A TRUE DUPLICATE

of the original coil is the only assurance of continued high performance. The special form in the photo above produces coils absolutely uniform in shape. Only one of these coils can correctly replace another coil from the same machine.

ELLIOTT ROTOR COILS ARE BAKED UNDER PRESSURE for homogeneous structure and close tolerance, and are properly treated at several points of manufacture with best grade insulating varnishes.

ONLY THE BEST AVAILABLE INSULATING MATERIALS, proven so in constant test, are used in Elliott coils. Insulation practice is considerably beyond standard practice for the voltage of the machine, insuring longer life, highest performance.

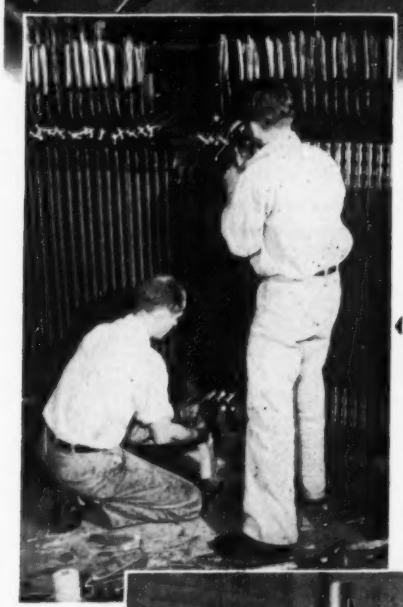
FOR BEST RESULTS have coils installed by Elliott factories or Elliott approved service shops. Ask your local Elliott field engineer for location of the shop best suited to serve you.

ELLIOTT Company

Q4-2

TURBINE-GENERATORS TURBINES MOTORS GENERATORS DEAERATING HEATERS EJECTORS CONDENSERS COMPRESSORS TURBOCHARGERS TUBE CLEANERS STRAINERS

No job too big for ELLIOTT approved service shops



Soldering and taping final connections in the big generator stator.

Close-up of service men inside the stator inserting wedges and lashing coils.

The 12,000-kva generator installation.

REWINDING 12,000-KVA VERTICAL WATERWHEEL GENERATOR

● Using factory-built coils and factory methods, service men of Larsen-Hogue Electric Company, Los Angeles, handle this big generator job with no difficulty.

The Larsen-Hogue Company is one of many carefully selected shops, strategically located throughout the United States, to service all types of electrical equipment built by Elliott Company. Together they comprise a trained and dependable service organization which stands back of every Elliott motor and generator. In addition to these Approved Service Shops, is the staff of Elliott factory-trained Service Engineers, and the repair facilities which are available at the factory for regular or special service.

For the location of the Elliott Approved Service Shop capable of handling *your* service job — no matter what its size — contact your nearest Elliott District Office or write Elliott Company, Ridgway Division, Ridgway, Pa.; or Elliott Company, Crocker-Wheeler Division, Ampere, N. J.

ELLIOTT Company

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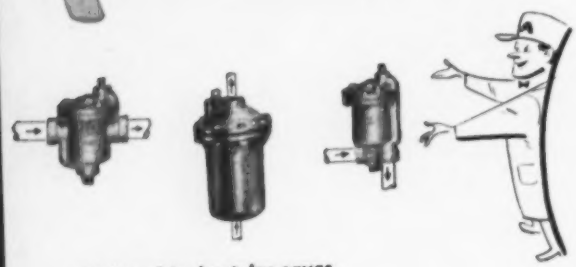
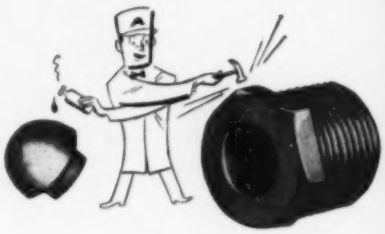
R2-26

For more data circle 501 on Post Card

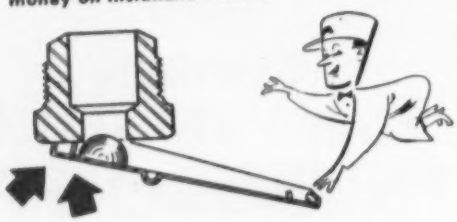
How Armstrong Traps Save you Money



Choice of body styles saves money on installation costs.

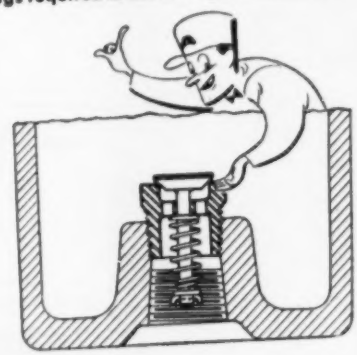


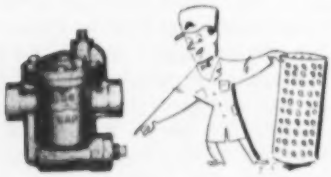
Hardened, ground and lapped valve and seat; stainless steel mechanism resists wear and corrosion—saves money on maintenance.



Two phase leverage means higher capacity in a smaller trap. Armstrong traps have optimum relation between leverage, valve travel, bucket weight, capacity and overall size.

This internal check valve saves labor and fittings required to install regular check valve.





This trap with built-in strainer costs less than separate trap and strainer—requires less labor and fittings to install.

Get the full facts on money-saving Armstrong traps. Send for free Catalog J. Clip and mail coupon today.

ARMSTRONG MACHINE WORKS
810 Maple Street, Three Rivers, Michigan

Gentlemen: Please send me a free copy of Catalog J, The Armstrong Steam Trap Book.

Name _____

Position _____

Co. Name _____

Address _____

Please Print

ARMSTRONG STEAM TRAPS

For more data circle 502 on Post Card

ENGINEERS' PREVIEW

THE RIDDLE of the machine was recently termed the most solemn challenge of our time by Dr. Lewis K. Sillcox, president of the American Society of Mechanical Engineers, in an address at the mid-year commencement exercises of Illinois Institute of Technology.

The machine, he said, has increased productivity to the point where our average citizen enjoys about a thousand more hours of leisure per year than his grandfather. The question that should engage our attention, said Dr. Sillcox, is whether this triumph of the industrial age is real or only potential.

* * *

INTERLINGUA is a new language that scientists and engineers are giving the western world something else to talk about — or with. It is a union of English, French, Italian, Spanish and Portuguese with a little German, but with the peculiarities of each language left out. After 25 years of research, a book on Interlingua grammar and an Interlingua-English dictionary have been issued; also, a book using pictures to teach the vocabulary is about half finished. Dr. Forrest F. Cleveland, of I. I. T., has written one of the first publications in the new language: a book on "Spectroscopia Molecular." He states that the new language is being accepted by scientists because they have to read in the other languages anyway and find that they understand most of the words in Interlingua. An example: "Energia es necessari pro toto que occurre in le mundo."

* * *

FIRST International Instrument Exposition sponsored by the Instrument Society of America will be held at the Philadelphia Convention Hall, September 15–21, 1954. Over 70 technical sessions have been arranged by the ISA, cooperating with related technical and engineering societies.

* * *

A COMMON PINE BOARD verifies the accuracy of an electronic width gage at U. S. Steel's Gary Sheet and Tin Mill. The gage is on an 80-in. hot strip mill; it scientifically measures and records the width of the racing, fiery-red steel strip by means of infrared rays, an intricate arrangement of prisms, rotating mirrors and related electronic equipment.

But to check this electronic device Rolland E. Peterson, department superintendent of the mill and his assistant, Charles Sanford, thought of having a crew member place the pine board under the hot ribbon of steel. The board is 4 in. wide and 8 ft long. The hot steel, operating at over 1500 fpm, burns its exact width into the board. The burn marks are then measured and checked against the electronic instrument.

* * *

HARRY C. BALLMAN has been appointed Executive Secretary of the Air Pollution Control Association. In this position, he is the senior incumbent of the Air Purification Fellowship maintained at the Mellon Institute of Industrial Research in Pittsburgh. In 1947, Mr. Ballman served on the Indianapolis Board of Air Pollution Control; a year later in Richmond, Va., as the City Smoke Regulation Engineer; in 1949, he went to Columbus, Ohio, in the same capacity.

* * *

THE REACTOR for the proposed atomic powered locomotive, announced recently by the University of Utah, is already on the designing boards of The Babcock & Wilcox Co.'s Atomic Energy Division, according to C. H. Gay, vice president in charge of the division.

Gay said that the reactor, employ-

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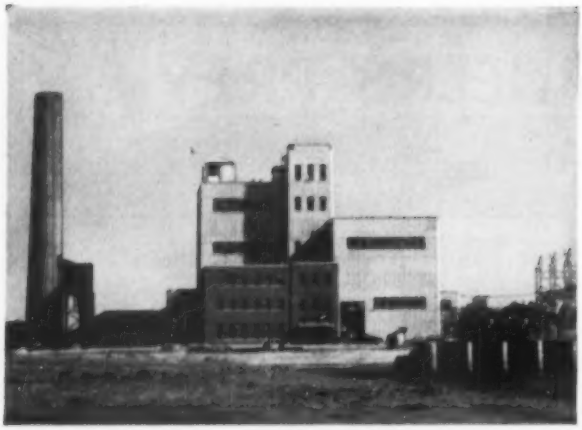
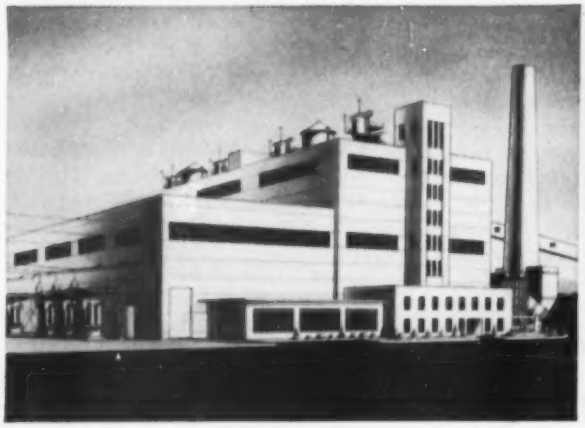
PUBLISHED SINCE 1896 FOR POWER ENGINEERS IN PRIVATE AND PUBLIC UTILITIES AND INDUSTRIAL PLANTS



Oh, I see



(upper:) Plant McManus near Brunswick, Georgia, went into service in November, 1952.

(lower:) Plant Hammond near Rome, Georgia, began service late in 1953.

Plant Yates at Whitesburg, Georgia, dedicated in October, 1952.

...they're using our valves at Georgia Power

Newest in their growing chain of giant power plants for expanding service in Georgia are these three plants. Indicative of their builders' desire to assure maximum dependability is their selection of OIC Valves for these plants.

Every OIC Valve is *precision-engineered* and *precision-made* to give longer, trouble-free service at no extra cost to you. OIC offers *precision-application help* in selecting valves best suited to each job.

OIC
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THE OHIO INJECTOR COMPANY
Wadsworth, Ohio

VALVES | **FORGED & CAST STEEL, LUBRICATED PLUG, BRONZE & IRON**

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ing fluid rather than solid fuel, was of extreme interest in the field. "Such reactors have been previously designed, but never for such a heavy demand of energy," he said. "Our studies based on engineering data collected over the 87 years of our company's existence, convince us that such a reactor can be designed, but we anticipate many problems before the job is finished." Some of the problems, Gay explained, include arranging for a sufficient amount of heat exchange between the fuel and the pressurized water in the limited space available and the problems of corrosion and of neutron damage. "How well these problems can be overcome will have a great bearing on the efficiency of the power plant of the locomotive, and consequently on how soon it will be built," he said. Gay also feels that such a reactor will find uses other than those proposed for it in the locomotive. Further details of this interesting reactor will be given soon in our companion publication *Atomics*.

HERE'S WHAT THEY TELL US

AS EVIDENCE that editors are sufficiently human to be flattered by compliments and pleased by suggestions, we cite **H. B. Wayne,** Ebasco Services, with a triple-action comment:

> "The cover design for POWER ENGINEERING is a decided improvement over that previously used. Having a table of contents as shown, permits quick and easy location of the subject matter. The article, How to Figure Performance Curves for Your Liquid Jet Pump, January issue, page 71, by Professor Iversen was excellent.
>
> "There are not many data available in textbooks and manufacturers' literature giving this type of information. It is suggested that future articles cover, in a similar manner, other power plant equipment: turbines, engines, pumps, compressors, heaters, condensers, etc. This would be well received by power engineers."

A long-time reader, **James Burns,** thinks:

> "The January issue is a definite improvement in your splendid magazine. I should like to see a column or two in each issue devoted to examination questions tuned to power engineers in large cities."

The editors would like to hear from other readers . . . would you like to see a department of this kind?

J. D. Waddell of Iowa Southern Utilities Company, and an alumnus of Georgia Tech, where Colonel Van Leer is dedicated to the dual production of engineers and footballers, tells us:

> "One comment which is most frequently made with respect to technical magazines in all fields of engineering is that many engineers maintain files of articles. All too frequently, the articles are arranged so they cannot be separated.
>
> "Therefore, I join the many, many engineers throughout the country in proposing that your technical articles, known to be of interest, be concluded so that the next article will not be affected. The most logical solution of this would be to insert advertising or other incidental material on the first or back page of each such article. It is my opinion that advertisers will not suffer but more likely profit by the goodwill created as a result of this worthy consideration."

This excellent suggestion cannot very well be followed. Our researches and surveys show that each copy is read by an average of five people, and if the first ones to receive it remove the articles, the issue would be of little value to subsequent readers. As a solution to this problem, we have made arrangements to send tear sheets and reprints of articles to those requesting them. This solves the problem of copies for the files and keeps the issues intact for future readers. These requests can be made on the bottom of the postcards bound in the issue.

From the atom capitol, **Paul Dickens,** ZIA Company, welcomes an old friend in a new dress, comments on the cover and continues:

> "It is difficult to recommend improvements for this magazine since the advertisements and the technical and practical information are all good sound practical ideas that can be applied around any power plant. Also, don't forget the cartoons are enjoyable, too."

The comic characters which help explain water treatment, mentioned on page 86 of the January issue, came in for a big play. **Clyde Erickson,** on the Board of Water and Electric Light Commissioners of Lansing, asks:

> "Can these be purchased or can they be obtained on a loan basis? Would like to make this presentation to the Second Annual Dairy Engineering Conference in Michigan State College, East Lansing. The attendance will be approximately 160 from 15 states."

For information about such presentations, you will have to ask the author: **Thomas H. Waldron,** Engineer-Custodian, Ebinger Elementary School, 7350 W. Pratt Ave., Chicago, 31, Ill.

M. K. Drewry of Milwaukee sends his commendations on the January issue, saying:

> "Three articles are being called to the Veep's attention. When you don't get notes of appreciation, don't make the error of feeling there is no appreciation."

Later, he also asks for some reprints of Crane Accidents Can Be Prevented, (October 1953 issue, page 82), a very popular article of which scores of reprints have been distributed.

F. D. Tierney, Northern States Power Co., is interested in the paint series by L. G. Jones and says:

> "Are these available in booklet form or will it be necessary for us to obtain copies of the back issues in order to have a file?"

This has been a very popular series, consequently tear sheets and back copies of many articles are no longer available. There are many requests of this kind, although the series has not yet been completed. We are considering gathering these articles together and publishing them in booklet form. When this is done, we will send copies to our friends who are thoughtful enough to get their names on the waiting list within the next 30 days. To the others, the cost will be $1.00 a copy.

On the question of estimating costs, **Herb Hayden** of du Pont says:

> "We have found that our plants, using the engineering department normal-time value as a standard, have approximately the same base effectiveness regardless of geographical location and experience, the same increase in effectiveness after the inception of a preplanning and measurement program. Our construction division experience indicates higher costs in New Jersey than in Florida or Texas. We very strongly lean toward the man-hour basis of comparison and would not consider a dollar comparison as being accurate."

With this conclusion, we believe all people with experience in different sections of the country would agree. We would, however, be interested in opinions as to the value of "incentive programs to preplanning and measurement programs." Undoubtedly, the two are closely related because an incentive program presupposes accurate planning, detailed instructions and availability of proper equipment. Both apparently produce improvements. Advocates of the two systems cannot agree as to whether the improvement is due to the increased remuneration under an incentive system or the natural inclination of capable workmen to meet a norm when the responsibility for performance is thrown on their shoulders.

R. C. Tegtmeyer, University of Wisconsin, tells us that the Industrial Instrumentation Institute originally planned for February 2 and 3, has been changed to May 10 and 11, and invites us to attend. We in turn, extend the invitation to our readers who are interested in this subject. Our friend's address is 3030 Extension Offices — Stadium, Madison 6, Wis.

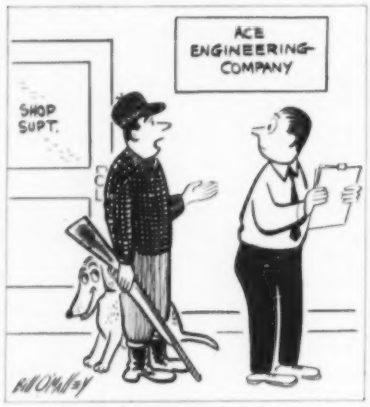
F. C. Hatch of M. T. Stevens and Sons, read with great interest the article on his North Andover, Mass. plant in the January issue and says:

> "If you are up this way next summer I wish you would take a day and visit our woolen mill in Franklin, N. H. where the end results are absolutely opposite to those required at Stevens Mill. I consider Stevens a dry woolen mill whereas Franklin is a wet operation.
>
> "It is there where we make practically all our power because we have such a tremendous process heat load and we are able to compete with the public service company for power at a cost of 4 to 5 mills per kw under the established rates. It would definitely interest you to see to what extent we go to snare the elusive btu."

Jess Cloud of Michel-Cather, in discussing cleaners for heat exchanger and boiler tubes, refers to the article in POWER ENGINEERING, September 1947, page 78, on "How to Operate and Maintain Water Tube Cleaners." An up-to-date article on mechanical cleaning, "How to Get the Most Out of Your Tube Cleaners" — appears in this issue.

J. H. Bell, U. S. Rubber Company, refers to the last paragraph of the article Electrical Development Seeks New and Wider Frontiers, (page 64, January 1954 issue) on electric precipitators, which says:

> . . . In a new system, the plates are supplied by high-voltage, high-power, pulse generator, capable of supplying high-voltage pulses of the order of 100 microseconds duration at a frequency of several hundred pulses per second. This has resulted not only in higher precipitation efficiency, but also in higher over-all electrical efficiency.
>
> "Who makes this equipment?" asks Mr. Bell. "Can it be adapted to our work of precipitating acid vapors? Can it be adapted to our new setup? These are some of the answers we should like to know. We are very much interested in obtaining this information. Can you help us out?"



"Can I have the day Boss? I'm not feelin' so good."

Possibly indeed, Mr. Bell, we can help you out. The answers are: for data on the equipment, ask H. J. White, Research Corp., Bound Brook, N. J., who presented data on it in AIEE paper No. 52-230. Judging from that paper, we think you could adapt the idea to your work.

Addressed to our reprint department, **R. R. Anderson** of Dearborn Chemical requests:

> "We should like your permission to reproduce the article, 'The Water Side Deterioration of Diesel Cylinders' which appeared in the January issue."

Ken Anderson of the Terre Haute Brewing Co., writes for reprints of Artificial Respiration — New Approved Methods, which appeared on page 61, July 1953 issue of POWER ENGINEERING, and is still in great demand. He says:

> "These will be used as official aids to teaching classes in the plant and as a community service. There is an immediate need for about 50 copies."

In the same mail, **J. P. Nelson** of the Northwest Nut Growers tells us:

> "An impulse of 65,000v at 5,000 amp is employed in the shelling of our walnuts. On the surface it would seem to be a heavy charge, but with each impulse of but 2/10,000 second's duration (0.0002 sec) the consumption is not large, especially if we complete the picture by saying that an average of 25 impulses per sec is the rate of feed.
>
> "Power at 220 a-c is fed through a 60-hp motor generator, syntron tubes, transformers and the resultant 65,000 d-c current stored in a bank of 68 capacitors. It is then triggered through a giant 18 contact rotor system to a double bank of 9 machines each for 18 cracking units."

C. H. Beaumont, Celanese Corp., wants reprints of **Grogan's** Graphical Solutions for Power Engineers: "Fuel Cost Comparisons," as shown on pages 66 and 67 of the January issue. Several hundred other engineers have requested these charts and the charts on voltage drops reproduced in part on page 82 of the same issue.

Ed Bossert, Bailey Meter Co., tells us of a Btu meter that:

> ". . . operates by multiplying the temperature differential of water in and out of the boiler by the rate of water flow through the boiler. This is accomplished by using our electronic type meters with resistance thermometer temperature-measuring elements."

This particular installation is at the Lincoln Electric Company and involves a bit of legerdemain not available a few years ago.

H. M. Thompson, Diamond Chain Co., refers to an article on page 70, January issue, written by Melvin S. Coben and dealing with testing of motor overload relays:

> "You stated in the article that the portable test set which was described is now available. We would like to have more information on this particular article along with the price of the portable test set, delivery and the manufacturer."

The manufacturer is Multi-Amp Corporation, Harrison, N. J. This firm will give you the information you desire.

From the Ramey Air Force Base in Puerto Rico, **William O. Tatman** writes:

> "They say everything comes to him who waits. Today I signed for my new power plant, just one year and 20 days behind schedule. Monday, February 1, 1954, the two new 2400-hp units will be on the line and I will take back some of the load I have had to farm out to an outside power company."

Bill Miller of Yarnall-Waring Co. writes us:

> "My appreciation for the very warm and hospitable reception you accorded Andy Ritter and myself when we visited your office last week."

The editors extend to all readers of POWER ENGINEERING *an invitation to visit us when you are in or passing through Chicago.*

RICHARD H. MORRIS
Editorial Director

G-E Motors Are Custom-built for Power Station Service!

OUTDOORS OR IN, General Electric power station motors are built to give you dependable, economical service. For example, the two vertical Tri-Clad* totally enclosed fan-cooled motors, shown here, have given consistent reliable performance under all weather conditions at the A. B. Paterson Steam-Electric Generator Station of New Orleans Public Service Inc.

GENERAL ELECTRIC'S 70 YEARS of experience in designing, building, and servicing motors for power station requirements assures you of getting the right motor for the job. Whatever your needs in power station motors, G.E. can furnish a complete line including dripproof, totally enclosed fan-cooled, totally enclosed air-water cooled, and weather protected motors in both horizontal and vertical construction.

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GENERAL ELECTRIC

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No service interruptions, no shutdowns, no loss of man and machine hours. While the line is *under full steam pressure*, packing is added as needed and the joints lubricated. That's all the maintenance required.

Compare this to the maintenance of conventional gland-packed joints. Consider the labor involved. Consider also the profit loss during shutdowns. It all adds up to GUN-PAKT.

Leading institutions, industrial plants and central station heating plants are standardizing on Yarway Gun-Pakt Expansion Joints. Investigate Yarway Expansion Joints yourself. Write for Yarway Bulletin EJ-1913.

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Philadelphia 18, Pa.

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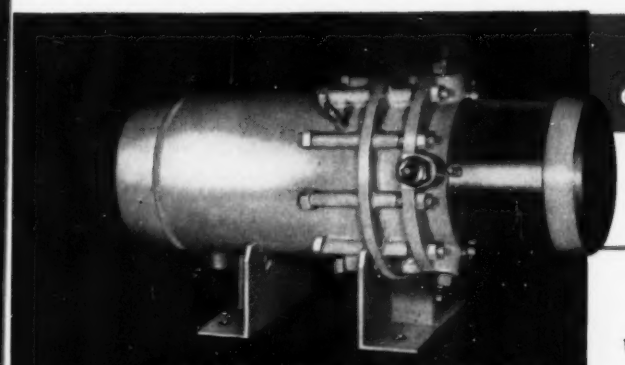
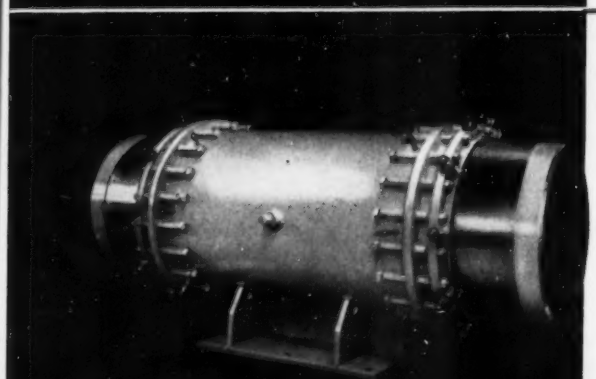
● To add packing to a Yarway Gun-Pakt Expansion Joint, just insert Yarway Plastic Packing, twist a wrench and the joint is tight . . . the job done. *There is no unpacking operation.*

YARWAY gun-pakt

EXPANSION JOINTS



Single end, welding-type Yarway Gun-Pakt Expansion Joint with base for pressures to 300 psi, 12 inch traverse.



Double end, welding type Yarway Gun-Pakt Expansion Joint with base for pressures to 300 psi, 24 inch traverse.

compare these maintenance records

	YARWAY GUN-PAKT JOINTS	CONVENTIONAL GLAND-PACKED JOINTS
STATE UNIVERSITY*	Required addition of only 3 slugs (45 cents) of packing in 5 years. Lubrication only once every 6 months. Total labor time of only 2 manhours in 5 years.	Same lubrication as Gun-Pakt, *plus* gland tightening, *plus* complete overhaul with shutdown for unpacking and repacking every 3 to 4 years. Time for overhaul—25 manhours per joint!
MID-WEST AIRFIELD*	Only maintenance was lubrication and addition of 2 slugs (30 cents) of packing per year. Total labor ¼ manhour per joint per year.	Lubrication and gland tightening required 8 manhours per joint per year—plus complete unpacking and overhaul every 2 to 3 years. Time required for overhaul—20 manhours per joint.
"BIG TEN" UNIVERSITY*	Lubrication only once every 2 months, with packing added as needed. Total labor time charged, 1 manhour per joint per year.	General maintenance requires 6 manhours per joint per year. Complete overhaul required every 2 to 3 years with unpacking and repacking—24 manhours per joint.

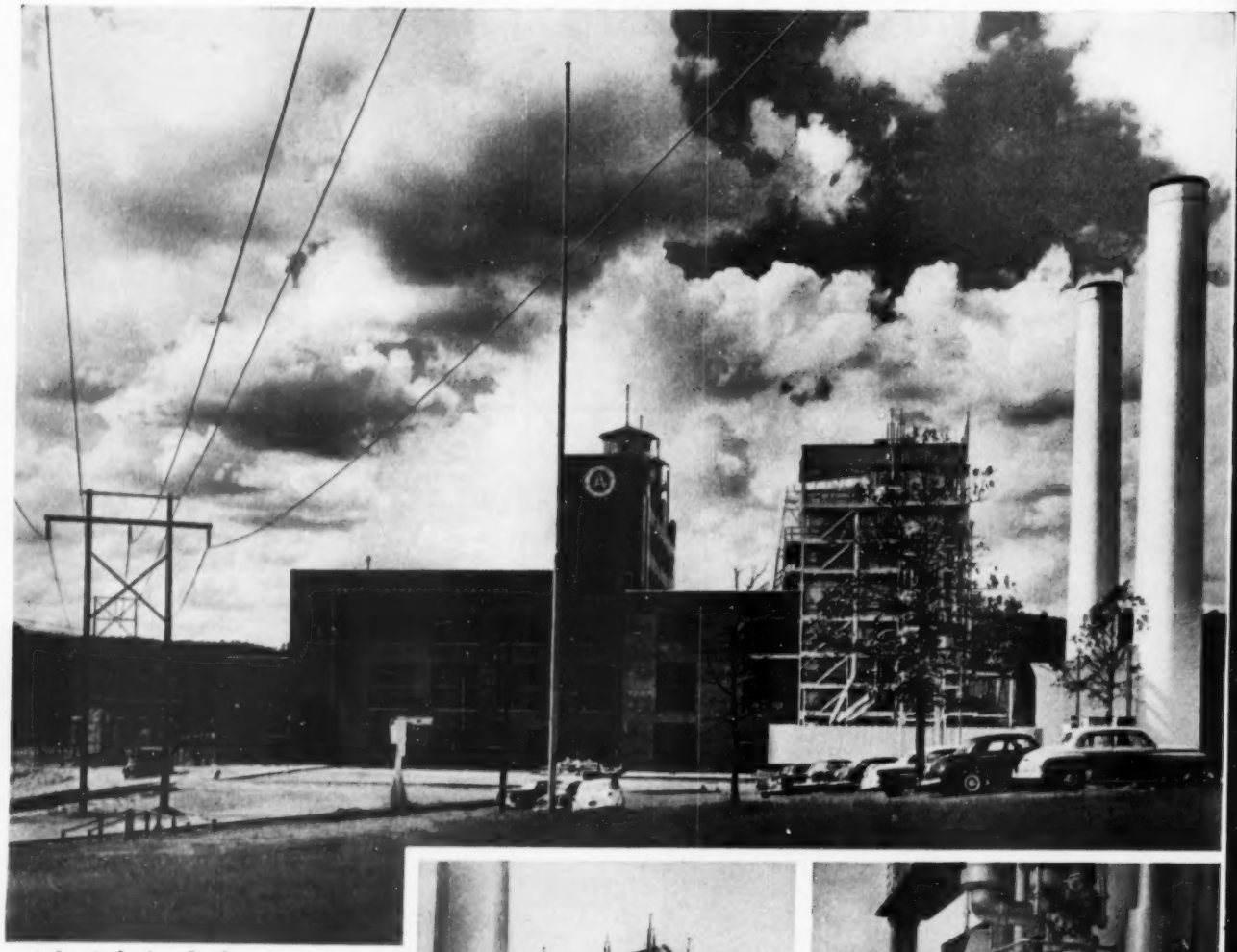
expansion joints

OTHER YARWAY PRODUCTS

BLOW-OFF VALVES
WATER COLUMNS AND GAGES
LIQUID LEVEL INDICATORS
IMPULSE STEAM TRAPS
FINE SCREEN STRAINERS
SPRAY NOZZLES
DIGESTER VALVES
HYDRAULIC VALVES

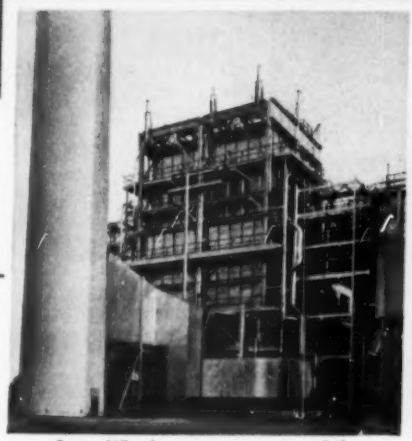
For more data circle 505 on Post Card

FOUR MORE OUTDOOR

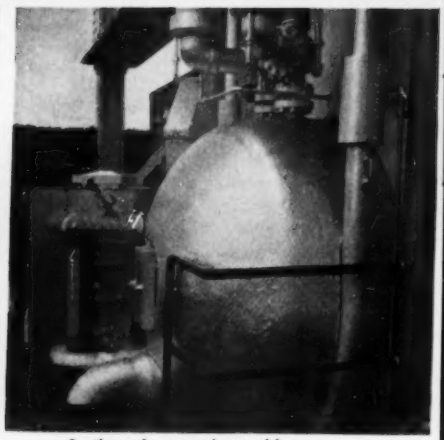


Lake Catherine Station of the Arkansas Power and Light Company.

All Units
Engineered By:
EBASCO SERVICES INC.



Foster Wheeler steam generator of the outdoor-type installed at the Arkansas Power and Light Company. Typical of those installed at Louisiana Power and Light Company, and Mississippi Power and Light Company.



Section of steam drum with external weatherproof covering protruding through water-tight, air-tight steam generator casing.

STEAM GENERATORS!

Foster Wheeler outdoor-type steam generators, each of 900,000 lb per hr capacity, now serving

Lake Catherine Station.....1 unit
ARKANSAS POWER AND LIGHT COMPANY

Ninemile Point Steam Electric Generating Station.....1 unit
LOUISIANA POWER & LIGHT COMPANY

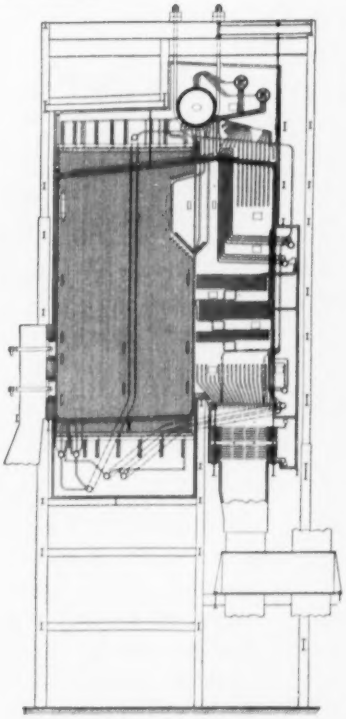
Delta Steam Electric Station.....2 units
MISSISSIPPI POWER AND LIGHT COMPANY

Reflecting the wide acceptance of the outdoor-type steam generator, these four Foster Wheeler units are all serving power plants in the South. Because of the traditionally mild climate in these areas, the minimum of weather protection is required for personnel, steam generating units and auxiliaries. This same basic design has proved practical and economical in the Northern States, the only difference being in the extent of weather protection provided.

Each of these new steam generators has a capacity of 900,000 lb per hr continuously, and 950,000 lb per hr for an eight hour peak. Each delivers steam at 1550 psi and 1005F at the superheater outlet. A superheat control condenser maintains steam temperature constant over an operating range from 600,000 lb to 950,000 lb per hr.

Because of the proven economy and suitability of outdoor-type construction under a wide variety of climates, Foster Wheeler units, such as these, bring a new abundance of low-cost power to help promote the industrial growth of the regions they serve.

The 145 ton drum of the Foster Wheeler outdoor-type steam generator being placed in position on structural steel framework at Lake Catherine Station.

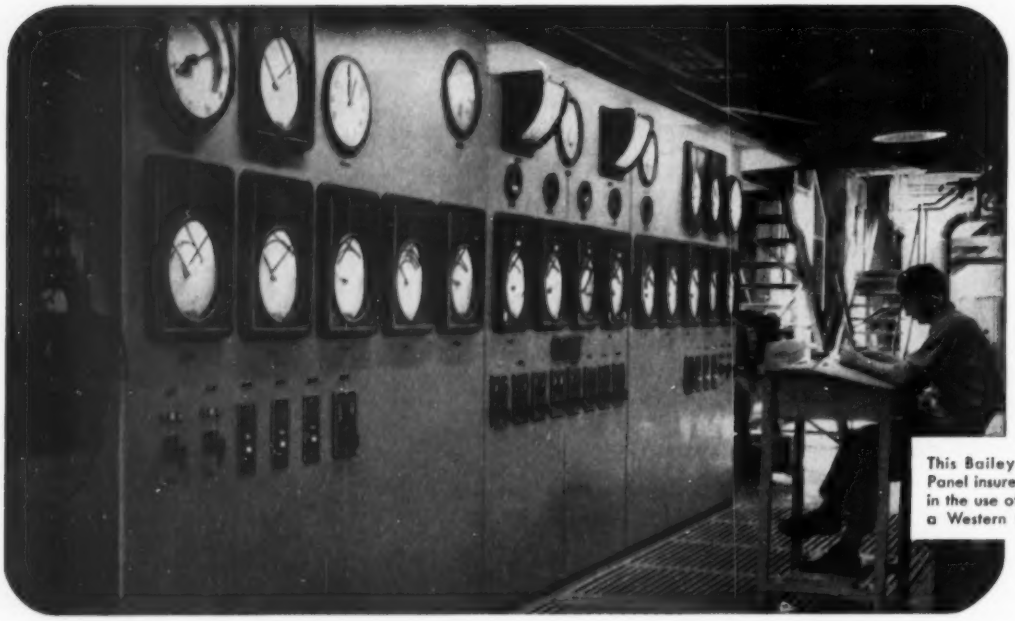


Cross-sectional elevation of the Foster Wheeler 900,000 lb per hr outdoor-type steam generator. Arrangement provides for modification of furnace for future pulverized coal firing.

FOSTER WHEELER

FOSTER WHEELER CORPORATION
165 Broadway, New York 6, N. Y.

For more data circle 506 on Post Card



This Bailey Boiler Control Panel insures high efficiency in the use of Fuel-Dollars at a Western Chemical Plant.

What's Your Fuel-dollar Efficiency?

A dollar's worth of fuel has the *same potential* energy, no matter who's boiler it fires. But how much of the energy actually gets converted to a usable form depends on how you operate your boiler.

That's where Bailey Controls can help. And, here's why, we believe, you'll get better fuel-dollar efficiency with Bailey:

1. **Complete Range of Equipment—fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. **Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. **Direct Sales-Service—conveniently located near you.** Bailey Meter Company's Sales-Service Engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

•

For better fuel-dollar efficiency—for more power per fuel-dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

A-109-1

BAILEY METERS

BAILEY METER COMPANY

1040 IVANHOE ROAD
CLEVELAND 10, OHIO

Controls for Steam Plants
COMBUSTION · FEED WATER
TEMPERATURE · PRESSURE
LIQUID LEVEL · FEED PUMPS

For more data circle 504 on Post Card

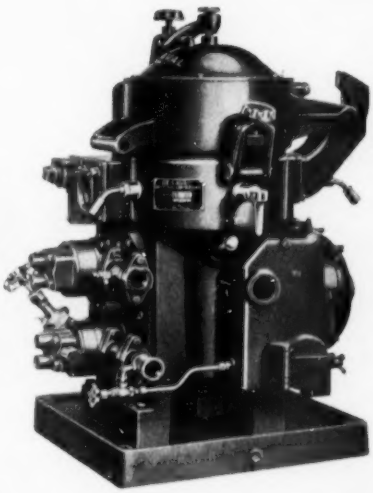
NO GETTING AROUND IT!

CONTINUOUS Purification Is Continuous PROTECTION

To give your power unit maximum protection, purify the lubricating oil ***continuously***. Even a De Laval machine gives most effective results when it is operated on continuous by-pass rather than on "batch."

This is so because the action of the centrifuge is itself continuous — the machine constantly discharges clean dry oil and sends the removed water to waste. Any leakage of water to the lubrication system shows up at once. There is no chance for any dangerous amount of condensate or other water to collect in the oil.

A De Laval Oil Purifier of proper size will clean all the oil in the system every six to eight hours. The exact rate of purification depends on the viscosity of the oil and the size and character of the contaminants. No getting around it, continuous purification provides continuous ***protection***.



THE DE LAVAL SEPARATOR COMPANY • Chicago POUGHKEEPSIE, N.Y. San Francisco

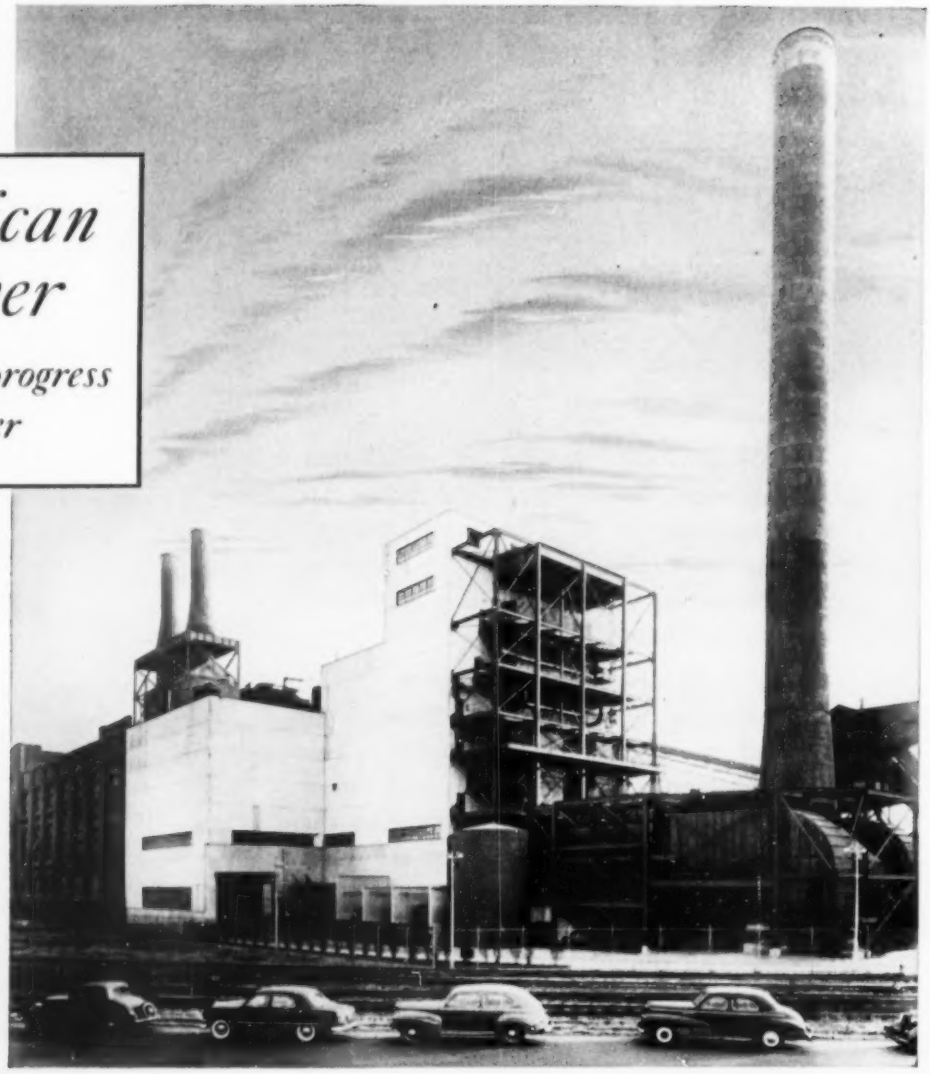
DE LAVAL *OIL PURIFIERS*

FOR MORE DEPENDABLE POWER PRODUCTION

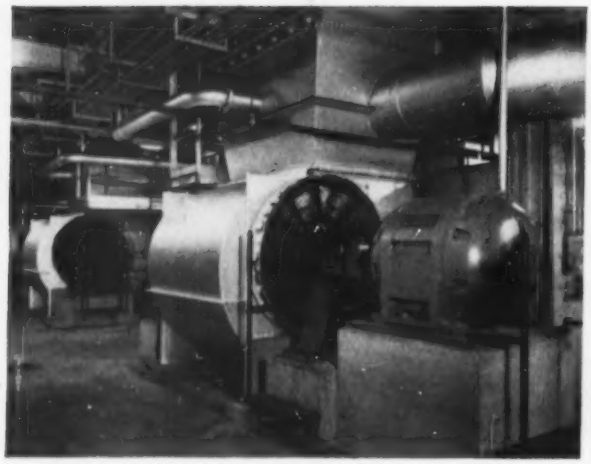
For more data circle 510 on Post Card

American Blower

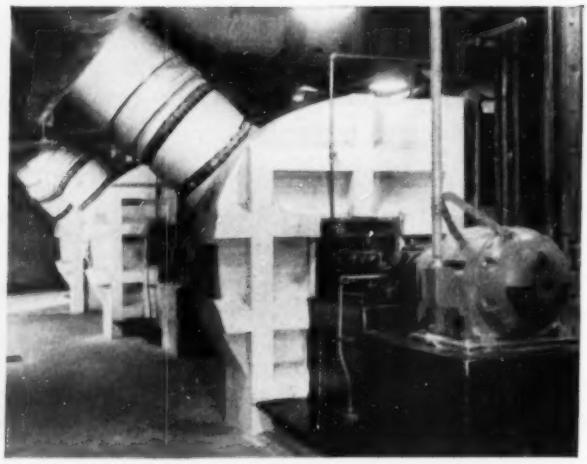
Reports on progress in power



Consolidated of Baltimore's new No. 3 Unit (foreground) at the Gould Street Generating Station has a capacity of 100,000 kw.



Placed in service in December, 1952, the Gould Street Station's No. 3 Unit is served by these two inlet-vane-controlled American Blower Forced Draft Fans.



Three American Blower HS Pulverizer Fans are used in the 75,000 kw. No. 5 Unit at Riverside Generating Station. Total capacity of the plant is 330,000 kw.

Consolidated of Baltimore Triples Generating Capacity in 20 Years

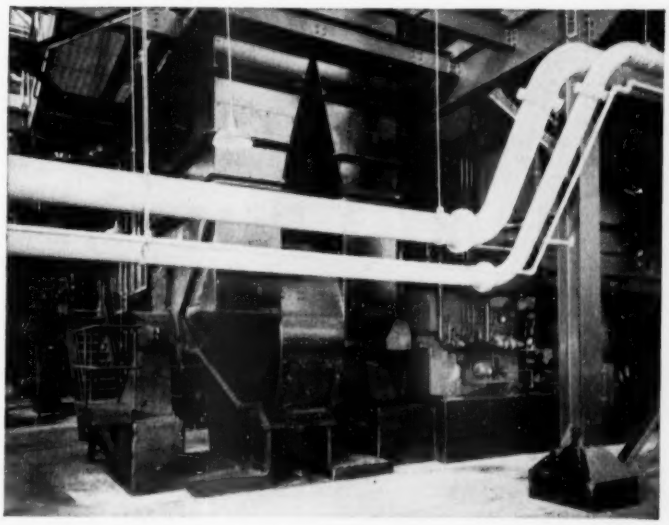
Farsighted program boosts total capacity to 830,500 kw.

Consolidated Gas Electric Light and Power Company of Baltimore serves a 2,283 square mile territory. To meet the rapidly growing needs of its customers, Consolidated of Baltimore must plan for the future — *years ahead.*

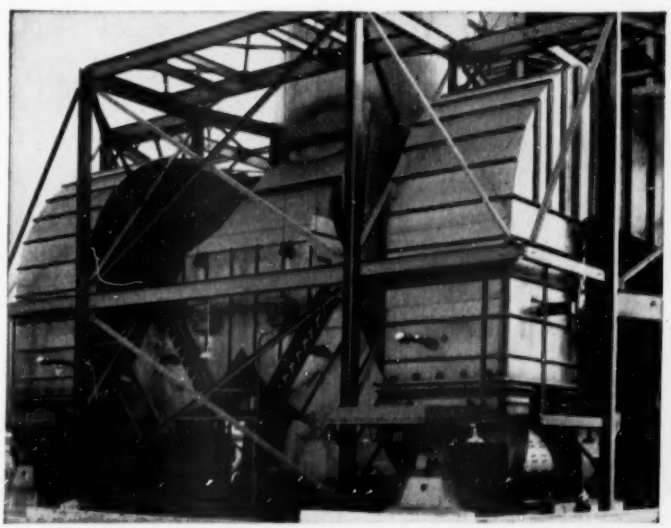
In the past 20 years, electric generating capacity of the company has been increased 3.48 times, from 238,850 kw in 1933 to 830,500 kw in 1953. In addition, completion of the first 125,000 kw unit of the Herbert A. Wagner Station (construction is now under way) will bring total capacity to four times the 1933 figure.

Like many other progressive, investor-owned utilities, Consolidated Gas Electric Light and Power Company of Baltimore has found it pays to use American Blower products.

If you are planning to modernize or expand your facilities, consult your nearest American Blower Branch Office, or write us direct for full information on Mechanical Draft Fans, Heavy-Duty Steam Coils, Dust Collecting Equipment and Gyrol Fluid Drives for boiler feed pumps and fan control.



Gyrol Fluid Drives are used for smooth adjustable speed control of both American Blower Induced Draft Fans (one shown here) at Riverside Station's No. 5 Generating Unit.



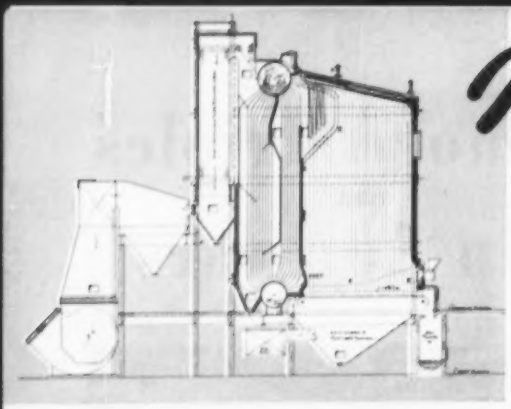
Two American Blower Induced Draft Fans are installed in the No. 3 Steam Generating Unit at the Gould Street Station. Units 1 and 2 also use American Blower Induced and Forced Draft Fans.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

AMERICAN BLOWER

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

For more data circle 508 on Post Card



Now Operating

at Utah-Idaho Sugar Company's Big New $7,000,000 Columbia Basin Beet Sugar Factory near Moses Lake, Washington . . .

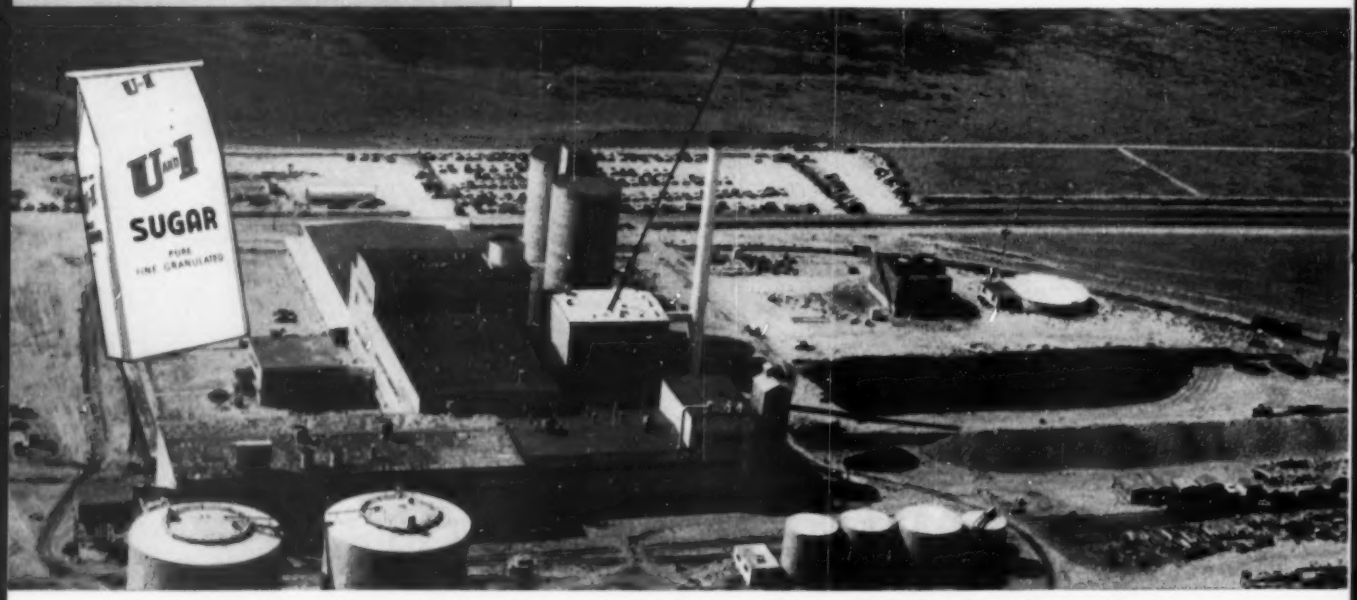
250,000 lbs./hr. RILEY BOILER FIRED BY A RILEY TRAVELING GRATE SPREADER STOKER

BOILER ENGINEERING DATA

Riley Model "RX"
Capacity 250,000 lbs./hr.
Peak Capacity 285,000 lbs./hr.
Design Pressure 475 psig.
Superheater Outlet Temp. 575°F.
Furnace Width 28'–9¾"
Furnace Depth 17'–2¾"
Furnace Height 32'–6"
Furnace Heat Release 26,830 B.T.U.
Grate Heat Release 761,000 B.T.U.
Size of Grate 28' x 19'
Efficiency 83.8%

Rising above the flat plains of the Columbia Basin is this large new sugar producing plant recently started up by Utah-Idaho Sugar Company. In its first year of operation this plant will produce in excess of 75,000,000 pounds of sugar, thousands of tons of molasses and dried beet pulp for livestock feed.

Steam generating equipment must be able to operate continuously and at full capacity during the entire production season. The most reliable equipment available is therefore mandatory. The Riley Erection and Service Departments completed this installation on a very close time schedule. There has been no interruption in steam production since it went on the line.



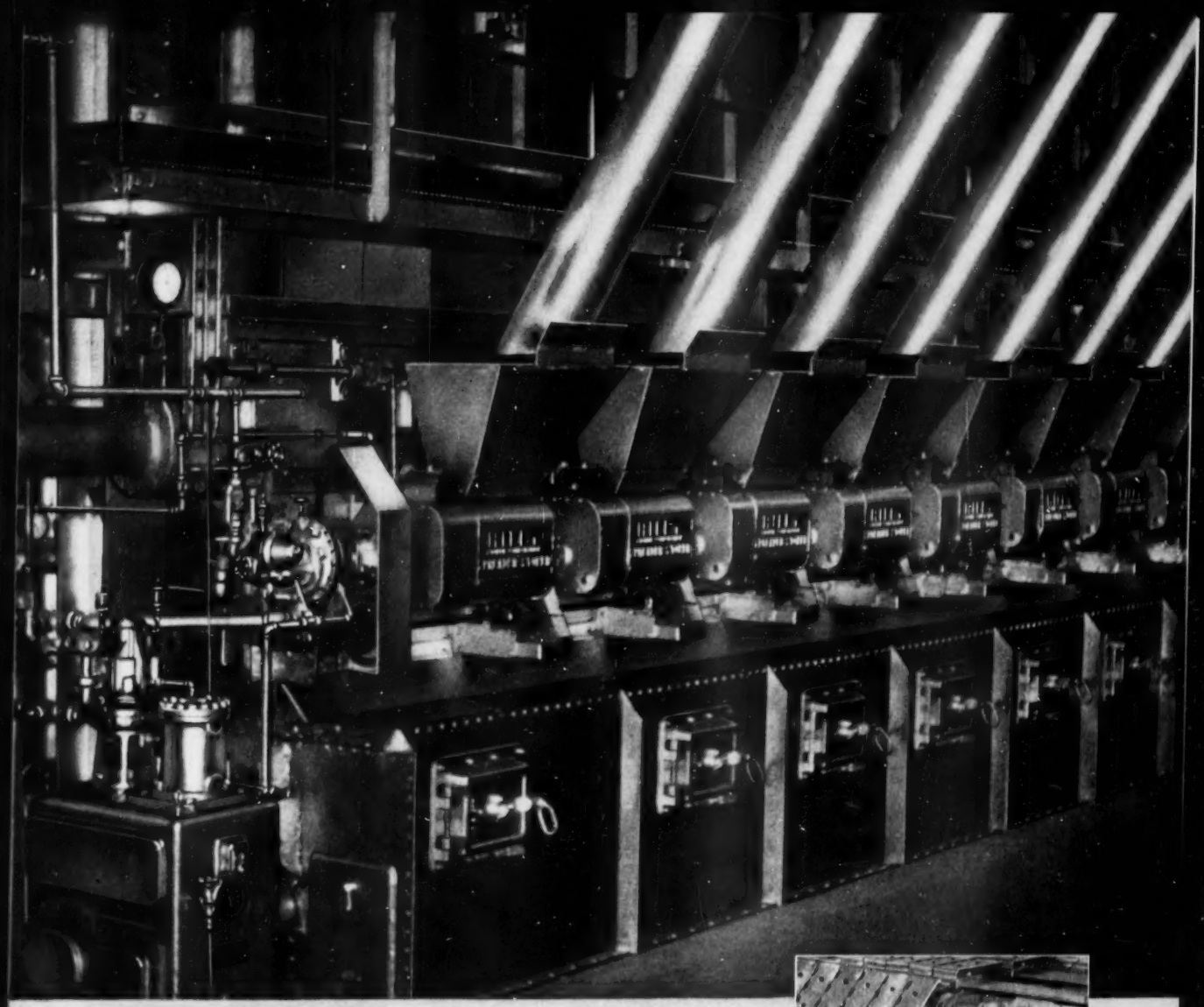
. . . and some other large Riley Traveling Grate Spreader Stoker Installations . . .

GAYLORD CONTAINER CORP.
Bogalusa, La.—250,000 lbs./hr.
Size of Grate—22' x 20'

KENNECOTT COPPER CORP.
McGill, Nev.—235,000 lbs./hr.
Size of Grate—28' x 18'

CHAMPION PAPER & FIBRE CO.
Canton, N. C.—200,000 lbs./hr.
Size of Grate—24' x 22'

MONTANA-DAKOTA UTILITIES
Mandan, N.D.—250,000 lbs./hr.
Size of Grate—26' x '20'



STOKER ENGINEERING DATA

Eight Riley overthrow feeders with adjustable distributor blades and grates. Dust-tight gear case and dust-tight self-lubricating feeding mechanisms. Front ash discharge.

Twin grates are powered by two drives—one motor powered, the other turbine powered; drives are inter-connected hydraulically and controlled by flow control valve for grate speed regulation.

RILEY FEEDER-DISTRIBUTOR

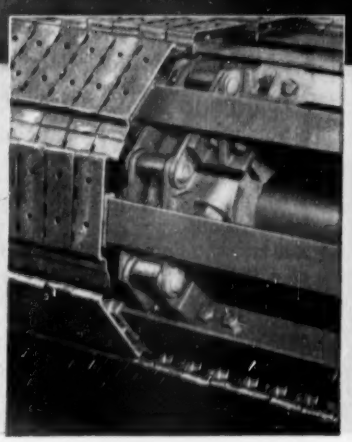
Feed is uniform and positive regardless of coal characteristics and moisture. Coal distribution is adjustable without necessity for shutting down.

RILEY HYDRAULIC DRIVE

The Riley hydraulically driven Grate Drive is completely enclosed and self-lubricated, and has no sprockets, chains and speed reducers. Hydraulic circuit provides positive overload protection. Complete grate speed control from zero to full load is provided. Drive uses little power and needs practically no maintenance.

RILEY GRATE SURFACE

View of the grate shows how special growth-resistant alloy clips overlap and separate to free themselves of ashes and clinkers. Use of small grate clips, two inches wide with a six-inch pitch, minimizes distortion.



TRADE MARK Rx REGISTERED

RILEY
STOKER CORPORATION

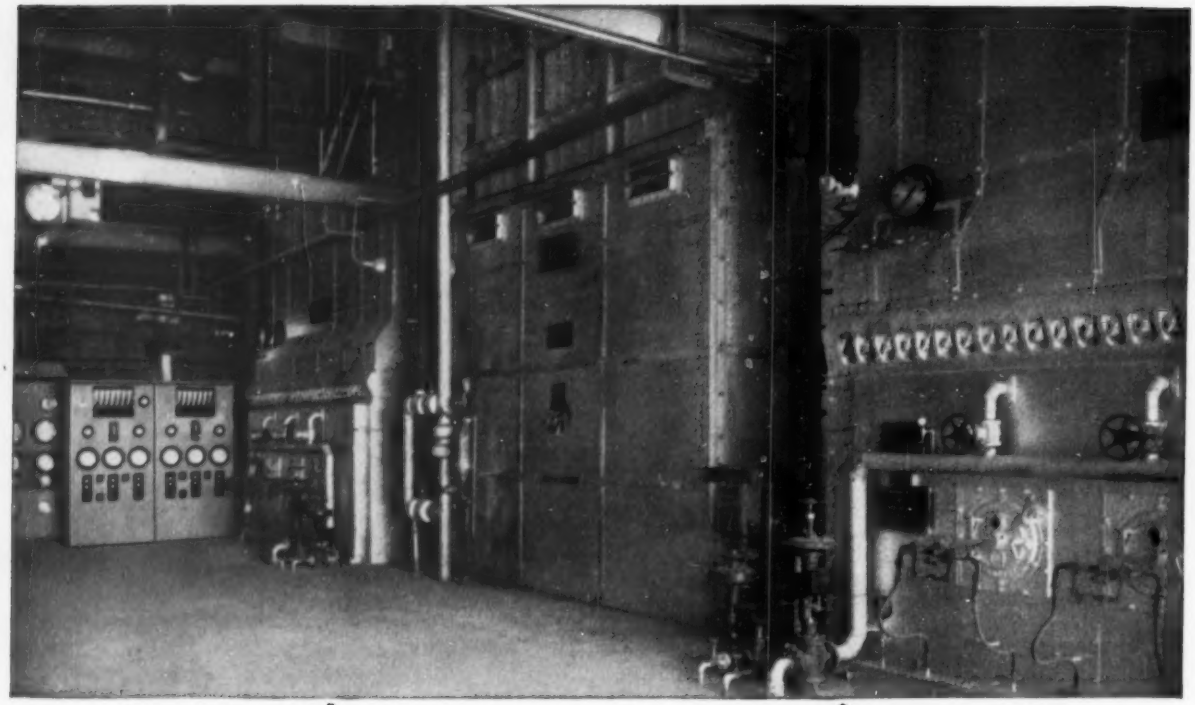
WORCESTER, MASS.

Boston, New York, Philadelphia, Buffalo, Washington, Pittsburgh, Cleveland, Detroit, Chicago, Cincinnati, Charlotte, New Orleans, Atlanta, St. Louis, Kansas City, St. Paul, Tulsa, Houston, Denver, Salt Lake City, Los Angeles, San Francisco, Portland, Seattle

COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • ECONOMIZERS
WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

For more data circle 507 on Post Card



Boiler room at Kansas State College. Republic instrument panel is at left. Boilers are arranged for either gas or oil firing.

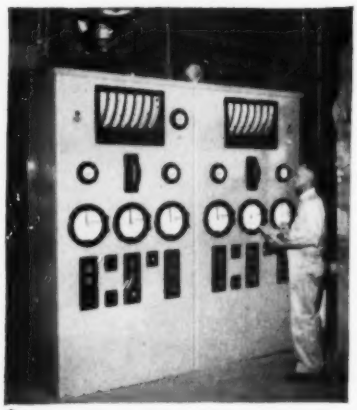
REPUBLIC *Automatic* COMBUSTION CONTROLS

Go to College to Cut Steam Costs

● At Kansas State College, a complete Republic combustion control system, feedwater level controls and instruments automatically operate two 50,000 pounds per hour boilers for maximum combustion efficiency. Fired by either oil or gas, these boilers generate steam at 225 psig and 500°F.

With Republic automatic combustion controls in this power plant, all loads, including "peaks", are met smoothly with steam output exactly matched to demand. Fuel costs per pound of steam produced are kept at a minimum 24 hours a day, seven days a week. Maintenance costs are kept low, too, by *continuous* proper operation of the boilers.

Whatever the size of your boiler, its draft arrangement, type or types of fuel to be fired and load conditions to be met, there's a Republic combustion control system that can bring these advantages to you. Our engineering staff, with more than 37 years *specialized* experience in combustion control systems, is at your service to help you get the system that exactly meets your needs. For your convenience, there's a nearby Republic field engineer to bring you all the facts. Write and make a date to see him soon.



Instruments on the control panel monitor boiler operation. If desired, the entire combustion system can be operated manually from this panel.

REPUBLIC FLOW METERS CO. ● 2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS

For more data circle 511 on Post Card

COUNT ON 25 YEARS OF ECONOMICAL SERVICE

from a

PREFERRED UNIT STEAM GENERATOR

Preferred Unit Steam Generators are available in sizes from 20 to 600 B.H.P. and pressures from 15 to 250 psi, to burn oil, gas or in combination

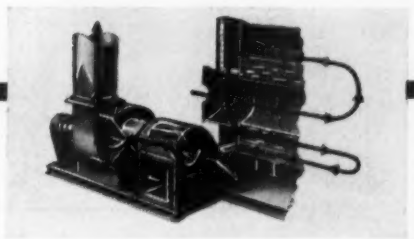
All units are factory fire-tested before shipment.

Because of the economies it realizes in low overall operating and maintenance costs, a Preferred installation pays for itself in *five years or less*, amortization included. Yet it gives 25 years expectancy of sustained high thermal efficiency (80% or more) over the entire range of load demand. Thus, four-fifths of the life of the installation costs you nothing!

10 DESIGN FEATURES ARE THE REASON

Incorporated in the Preferred Unit Steam Generator are ten design features which make possible the remarkable record of this "packaged" boiler. Other makes may have some of these features, but only the Preferred has ALL TEN. They are combined to assure lowest cost steam generation by cutting fuel consumption by 10% or more and, above all, by cutting to a minimum such maintenance costs as refractory repairs, tube cleaning and corrosion-caused replacements. Although hundreds of Preferred Generators are in daily operation, there has never been a single case of furnace loss. There has never been a single loss of a pressure vessel.

The inter-related functions of Preferred's ten design features are discussed in Bulletin 2000. You'll find it interesting and profitable to study. Write for a copy.



EXPANSILE PRECIPITATOR

Holds and contains entrained non-combustibles and insures clean, smokeless operation. It makes possible the maintenance of maximum gas velocities in all tubes at all times by preventing the build up of deposits, particularly at the last pass.

The Expansile Precipitator is one of the 10 design features which insure long service life and low overall maintenance and operating costs. Here are the other nine . . .

- Five Sq. Ft. of Heating Surface per Boiler HP
- Four Pass Gas Travel
- Down Draft Design
- Induced Draft
- Intermediate Furnace Position
- Anti-Stress Deck
- Staggered Tubes
- Dual Purging Action
- Full Automatic Oil and/or Gas Burners

PREFERRED UTILITIES MFG. CORP.

1860 BROADWAY, NEW YORK 23, N. Y.
DEPARTMENT PE-3

For more data circle 512 on Post Card

R/M's BIG 7 Packing Types meet 95% of all packing needs

Triplex pumps like this one, which is used to supply hydraulic pressure for molding presses, give top performance with R/M Vee-Flex®, a packing included in Type 7 of R/M's "Big 7" Packing Types.

Let R/M packings reduce your downtime

With R/M's "Big 7" Packing Types you will be able to practice preventive rather than corrective maintenance. With them you will have greater assurance of machinery protection and a chance to schedule your downtime. You will, because this basic line of just seven field-tested packing types is engineered to give custom-built performance in all but the very rarest packing applications. Your plant can probably standardize on just three or four of R/M's "Big 7" Packing Types. If so, this also means lower inventories and simplified ordering. Your R/M distributor has the full details. Call him in and start benefiting right away.

R/M PACKINGS FOR MAINTENANCE PURPOSES ARE SOLD ONLY THROUGH AUTHORIZED R/M DISTRIBUTORS

RAYBESTOS-MANHATTAN, INC., PACKING DIVISION, MANHEIM, PA.

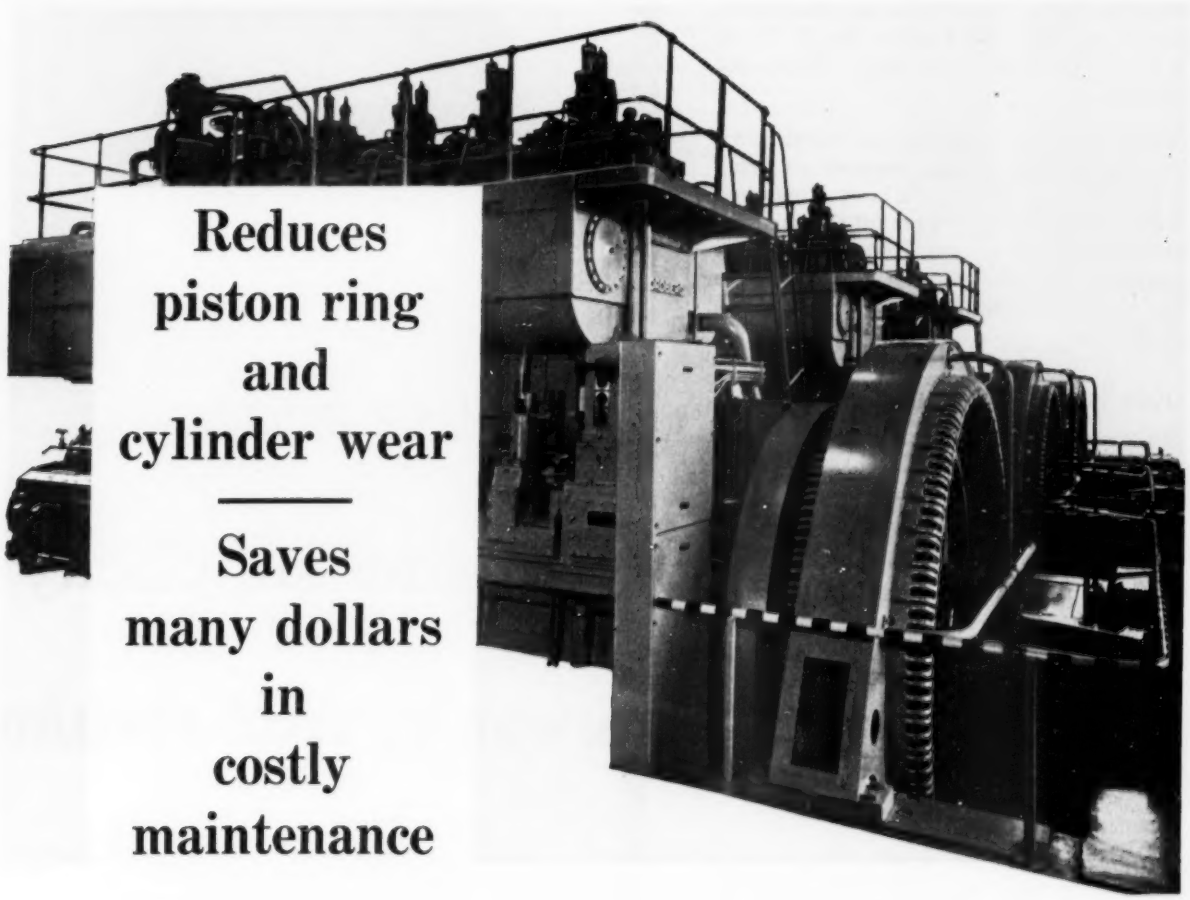
R M **BIG 7 PACKINGS**

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Passaic, N.J.; Neenah, Wis.; Crawfordsville, Ind.; Peterborough, Ontario, Canada.

RAYBESTOS-MANHATTAN, INC., Packings • Asbestos Textiles • Industrial Rubber, Engineered Plastic, and Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts • Radiator Hose • Bowling Balls

For more data circle 513 on Post Card

Shell Rotella Oil



Reduces piston ring and cylinder wear

Saves many dollars in costly maintenance

These dual-fuel engines in the Municipal Power Plant at Houma, Louisiana, supply dependable, low-cost electric power to the entire city. Shell Rotella Oil is the cylinder lubricant.

Here's just one of the many diesel power plants that depend on SHELL ROTELLA OIL for reduced wear of engine parts . . . lower maintenance cost.

The anti-corrosive action in Shell Rotella Oil combats the major cause of engine wear . . . cylinder and piston ring wear caused by acid action from the by-products of incomplete combustion and condensation.

Tougher lubricating film in Shell Rotella Oil gives cylinders and rings greater protection . . . minimizes wear. Its effective detergent-dispersant action prevents harmful deposits.

Write for technical information. See for yourself how Shell Rotella Oil can help reduce your engine maintenance costs.

SHELL OIL COMPANY

50 WEST 50TH STREET, NEW YORK 20, NEW YORK

100 BUSH STREET, SAN FRANCISCO 6, CALIFORNIA

SHELL®

For more data circle 514 on Post Card

When you need instrument service . . .

Ever have a tire blow out while you're traveling late at night? If it happens near a service station, you're lucky. But if it's on a lonely road far from town, you've got trouble.

When it comes to service on instruments, you don't need to take chances on being lucky. Because when you have Honeywell instruments, you've always got the comfortable feeling that service is close at hand . . . whenever and wherever you want it . . . from the world's biggest instrument service organization.

OVER 110 SERVICE CENTERS

No matter where you may be, there's a Honeywell service man near you. Offices are located in more than 110 cities of the United States and Canada, near every large production center.

When you run into trouble, just telephone or wire the nearest of these offices. You'll get a service specialist promptly . . . often within a few hours. This quick attention to your needs protects your production schedules, and prevents delays that can cause costly stoppages.

TRAINED PERSONNEL

Honeywell service men are thoroughly trained for their important responsibilities. In the Honeywell factories, hand-picked men learn both the theory and practice of instrument maintenance. Then they serve an apprenticeship in the field offices, to gain further first-hand experience. You can be sure that the Honeywell man who calls at your plant is a qualified specialist, well versed in the practical art of keeping good instruments in the best condition.

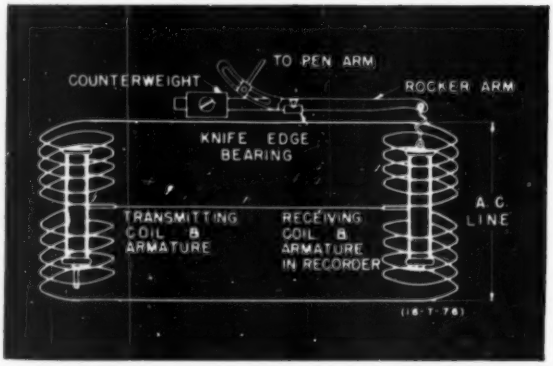
PERIODIC SERVICE

But why wait for emergencies—when you can prevent them with periodic service. Under a simple contract, a Honeywell man will visit your plant at regular intervals to inspect, clean and adjust your instruments and controls. The plan is economical, and can save you hours of production time. Our nearby office will be glad to give full details on Honeywell Periodic Service.

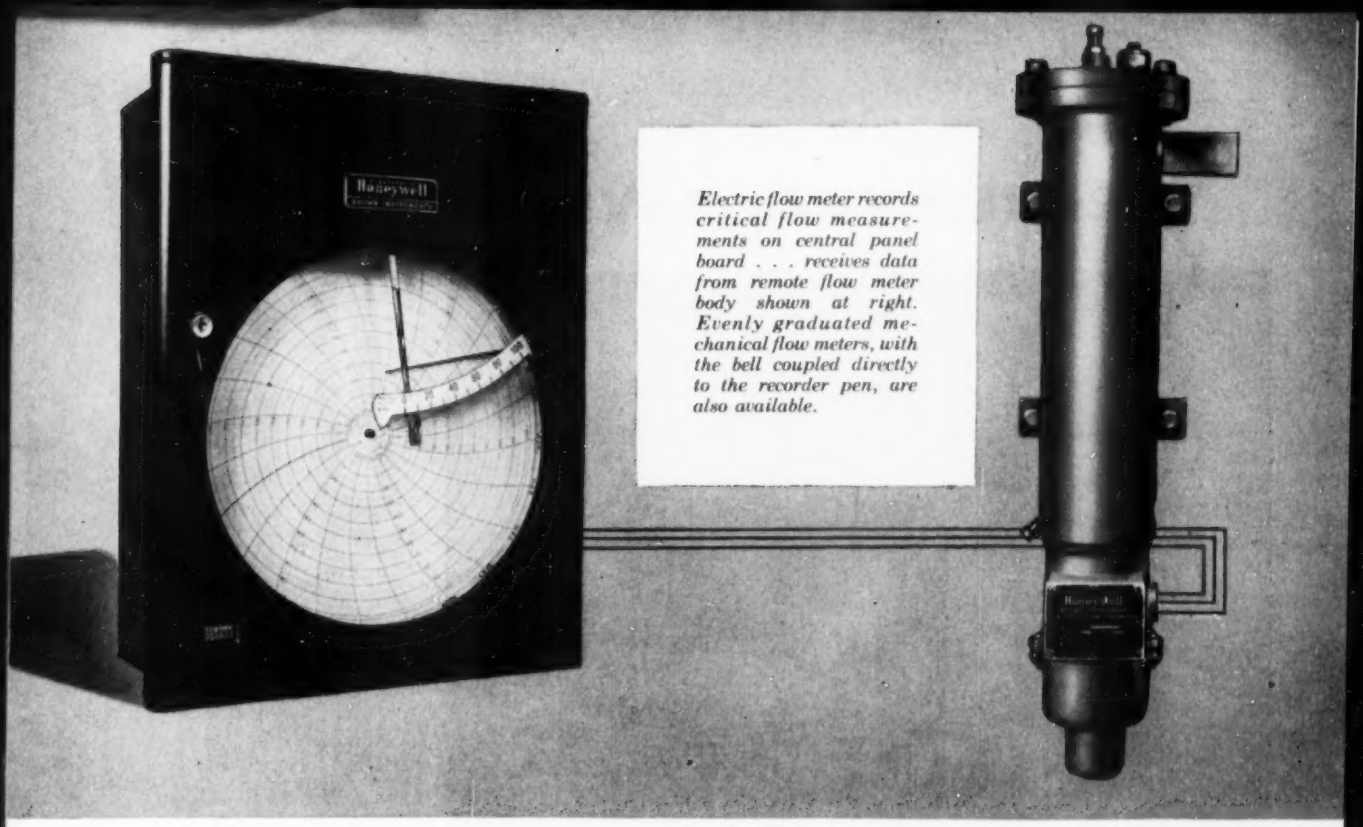
Better accuracy...

greater simplicity

..... *for steam*



ELECTRICAL TRANSMISSION SYSTEM *brings flow data instantaneously and accurately from the remote meter body to the Brown Flow Meter. The inductance bridge system consists of a transmitting coil and armature at the meter body, and an identical coil and armature in the instrument. The receiving armature faithfully duplicates the movement of the transmitter.*



Electric flow meter records critical flow measurements on central panel board . . . receives data from remote flow meter body shown at right. Evenly graduated mechanical flow meters, with the bell coupled directly to the recorder pen, are also available.

plant flow measurements

WHEREVER your steam plant uses measurement of flow . . . for steam, feedwater, make-up water or oil . . . Brown Electric Flow Meters offer every performance feature you could require. Compare these advantages:

Electronic integration . . . using high-speed, high-sensitivity electronic scanning . . . provides exceptional precision in totalizing flow. This unique integrator completely eliminates friction loading of the recording system. It's extremely simple; has only three major parts, and can be calibrated in only a few minutes.

Electrical transmission . . . ideal for centralized control . . . permits the meter body and instrument to be located hundreds of feet apart without loss of sensitivity. A precision-made inductance bridge transmission system (illustrated on the opposite page) gives faithful reproduction of remote measurements, and eliminates the problems of panel pipe connections.

Evenly divided chart assures easy readability and high accuracy at all flow values . . . no crowding of divisions at the low end of the scale.

Brown Electric Flow Meters are available in both square root and evenly graduated type meters with ranges applicable to practically all steam, water and oil measurements. Your nearby Honeywell sales engineer will welcome the opportunity to discuss your specific needs . . . and he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● **REFERENCE DATA:** Write for new Catalog 2320, "Flow Meters, Indicating, Recording, Controlling."

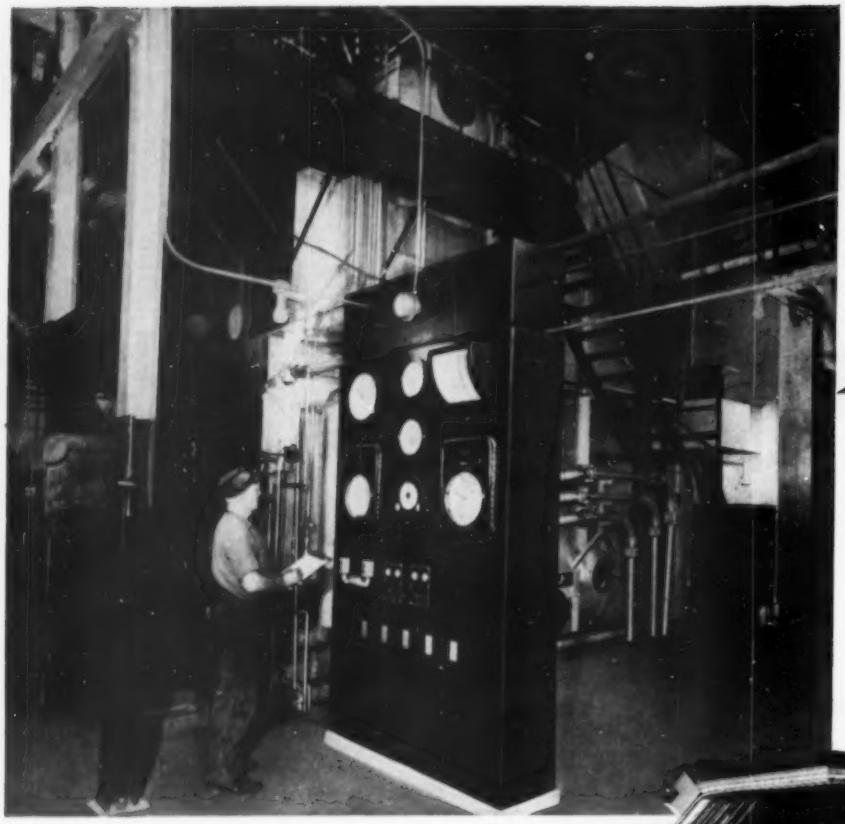
MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

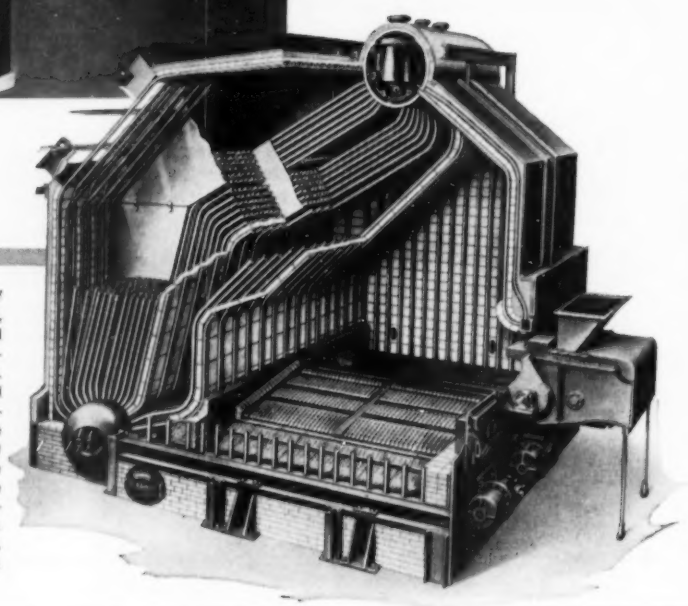
First in Controls

For more data circle 515 on Post Card

VERIFIED FUEL SAVINGS



Boiler operator checks readings on control panel of company's new stoker-fired B&W Integral-Furnace Boiler, Type FF, which has performed so satisfactorily that fuel savings of more than 40 per cent have been estimated.



View of typical stoker-fired B&W Integral-Furnace Boiler, Type FF, similar to unit in service at Food Machinery & Chemical Corporation's Middleport, N. Y. plant. Suitable for stoker, gas, and oil firing, this B&W Unit is available in a steam capacity range of 8000 to 50,000 lb per hr at pressures to 600 psi. Complete design and operating details are described and illustrated in Bulletin G-71. Write The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

with a B&W Integral-Furnace Boiler

at

FOOD MACHINERY & CHEMICAL CORPORATION

"Good job—well done", is the comment of the Niagara Chemical Division of Food Machinery & Chemical Corporation, regarding the installation and continuing superior performance of a B&W stoker-fired boiler and air heater at this plant. Data on a weighed-coal metered-water test, run continuously for three days, showed that 128,180 lb of 13,105 Btu coal were required to produce 1,464,400 lb of steam. The operating conditions were—100 psi boiler pressure—feedwater at 225 F. The overall efficiency of this B&W Unit was calculated at 86.6% against a guaranteed 84% at 20,000 lb of steam per hr.

Plans for this installation at the Middleport, N. Y. plant followed central-station principles and were based on a complete survey, including operating data, made by the consulting engineer engaged by this nation-wide organization. At this point B&W engineers took over to handle complete erection . . . to place the boiler in operation . . . train operating personnel . . . and, finally, to turn over to the Niagara Chemical Division, a satisfactory, efficiently operating B&W unit that has since continued to live up to its reputation for reliable, economical service.

Service-Proved

COST SAVING FEATURES

of B&W Integral-Furnace Boilers for Steam Requirements from 2,800 to 350,000 Lb. Per Hr.

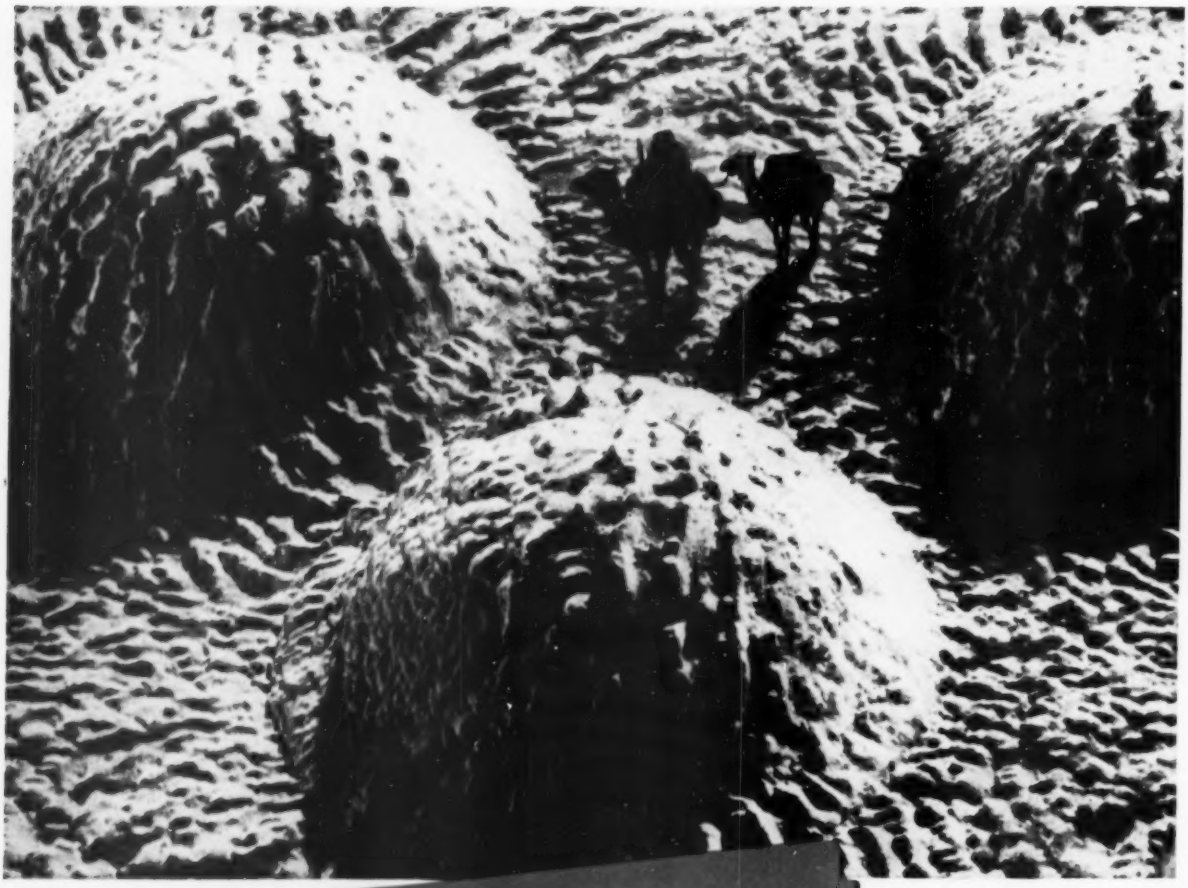
- Minimum floor space and headroom requirements
- High fuel economy
- Smokeless combustion
- Adaptable to all fuels and firing methods
- Economical fast steaming
- Water-cooled furnace
- Clean, dry steam at all ratings, even with high boiler water concentration
- Quick response to wide and heavy load swing demands
- Easy to inspect and clean
- High availability with least attention

BABCOCK & WILCOX

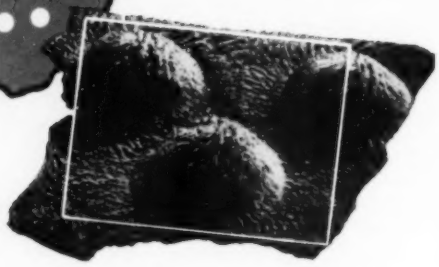
BOILER DIVISION

G-591

For more data circle 516 on Post Card



Desert Waste...



Rectangle in small photo shows area of scale sample in large illustration. "Hills" are scale-covered rivet heads. Approximate size of sample: 7" x 5". *Nalco Laboratory photo.*

THIS "desert" was formed under water—improperly treated boiler water. It represents needless waste in several ways... Boiler down time... Overheated drum and rivet metal... Loss of heat transfer efficiency... Sluggish response to load changes.

Since the scale was removed, The Nalco System has kept the boiler clean-to-metal and corrosion-free continuously—and economically. Where conditions require uninterrupted boiler operation, The Nalco System can also be utilized to remove old scale, as well as prevent new deposits. Either way, The Nalco System is your assurance of *permanent water treatment results.* Write for prompt action on your problems.

NATIONAL ALUMINATE CORPORATION
6224 West 66th Place
Chicago 38, Illinois

Canadian inquiries should be addressed to Alchem Limited, Burlington, Ontario

THE Nalco® SYSTEM • **Serving Industry through Practical Applied Science**

For more data circle 517 on Post Card

HELPFUL BULLETINS

PUMPS AND PUMPING

101 How to Care for Vacuum Pump — Dozens of practical tips on installing, operating and maintaining vacuum pumps and systems are provided in 16-pp Bulletin 755. Contains hints on the proper way to make leakproof connections in vacuum piping layouts; recommended types of gages, valves, fittings and gaskets; trouble-shooting procedures to follow when pump is knocking, won't start or won't make a satisfactory vacuum; and "do's and don'ts" for trouble-free service. F. J. Stokes Machine Co.

102 Controlled Volume Pumping — Bulletin 440, 24-pp, describes company's line of Pulsafeeder diaphragm-type controlled volume pumps, stressing the maintenance free feature of no stuffing box. Emphasizes multiple functions of pump such as chemical feeder, meter, filling machine — also versatility on hard-to-handle chemicals. Describes manual and automatically-controlled types, giving capacities, sizes, specifications, rating tables. Illustrates Auto-Pneumatic Pulsafeeder, chemical water treatment, and transfer pumps. Process Equipment Div., Lapp Insulator Co., Inc.

ELECTRICAL EQUIPMENT

103 Geared Turbine Generators — Bulletin 1969, 24 pp, describes geared turbine generators of 200 to 1500 kw, for both a-c and d-c service. Gives engineering and construction features of the generators, including two types of governing arrangements, hand and automatic nozzle controls. Stresses low initial cost, high efficiency, other advantages offered by these units. Worthington Corp.

104 Feeder Voltage Regulator — Company's Transformer type 5/8 per cent step feeder voltage regulator (Type AFR) is described in 16-pp Bulletin 01B6056D. Lists advantages of unit-type construction (exclusive to regulators 750 kva and below); quick-breaking tap-changing mechanism; automatic control and voltage integrator. Allis-Chalmers Mfg. Co.

105 Station-Type Arresters — Bulletin GEA-1304L is a 28-pp booklet on station-type arresters. Describes operation and design of a new Thyrite magne-valve arrester combining magnetic action and valve action. Application information and a guide for selection of arrester ratings are also provided. General Electric Co.

PROTECTIVE COATINGS

106 Corrosion Protection Data — A detailed study of the performance of various protective coating systems, this bulletin gives test data on 11 coating systems exposed up to 83 weeks in hydrochloric acid atmosphere. Illustrated with photos, includes corrosion-failure time comparison chart. Gates Engineering Co.

107 For Waterproofing, Decorating Masonry — Brochure A.I.A. 25-C-2 describes methods of combining decoration with waterproofing of masonry surfaces, including brick, asbestos shingle and concrete, by use of Pruftite masonry paints. User's Guide gives application, surface preparation and specification data. Pruf-coat Laboratories, Inc.

VALVES, TRAPS, PIPING

108 Diaphragm Motor Valves — Catalog 800, 36 pp, describes, illustrates manufacturer's Series 800 diaphragm motor valves, with double and single seated, low flow, venturi and three-way bodies. Tables give specifications, dimensions, ordering information. Industrial Div., Minneapolis-Honeywell Regulator Co.

109 Blow-Off Valves — Bulletin B-426, 20 pp, on blow-off valves for boiler pressures up to 400 lb wsp, contains installation recommendations, construction information on Yarway seatless and double-tightening blow-off valves. Gives full ordering data, including prices. Yarnall-Waring Co.

110 Valve Servicing — A 30-min service operation for welded-bonnet integral-seat valves that does not require their removal from the line is described in Bulletin 531. Besides giving service procedure, includes a blueprint for making the simple tools required. Edward Valves, Inc.

111 Jacketed Valves — Data Units 220 and 221 describe operational features of jacketed valves for heated-cooled gages or wherever small jacketed angle valves are required. Full specifications are included, also cutaways showing construction. Jerguson Gage and Valve Co.

112 Solenoid Valves — Bulletin 500A covers manufacturer's line of solenoid valves for automatic or remote control of steam, air, gas or liquid flow, in sizes from ¼ to 3 in., handle pressures up to 1200 psi (steam to 150 psi). Describes 25 types, giving application, operation, specifications, prices. Discusses waterproof and oilproof solenoid coils for temperatures up to 450 F. J. D. Gould Co.

113 Engineered Flow Control — "Solve These Flow Control Problems," is a bulletin covering both standard and custom-built valves for gas and oil heating applications, refrigeration and air-conditioning systems and general industrial use. Concise descriptions of capacity, orifice and connection sizes, lifts are given. A-P Controls Corp.

114 Automatic Regulating Valves — Catalog 207, 24 pp, describes manufacturer's pressure regulating and relief valves, for steam, air, water and gas. Includes a descriptive index and tables giving capacity factors, basic steam and water capacities, dimensions and weights; explains capacity computation. Illustrates, describes controls for steam and hot fluids, air and water; other company products. Schade Valve Mfg. Co.

115 Air-Operated Butterfly Valves — Bulletin 1701, 12 pp, replacing company's previous catalog, lists specifications of butterfly valve bodies and diaphragm motor operators. Includes tables of allowable pressure differentials to aid in selection of properly sized bodies and operators. Industrial Div., Minneapolis-Honeywell Regulator Co.

116 Steam Traps — To aid power engineers and maintenance men select their steam traps, Bulletin 154 gives tables of specifications and capacities of manufacturer's Super-Silvertop traps, including sizes and pipe connections, pressures, weights and list prices. Gives technical data on strainers for pressure regulating valves and metering devices, liquid and gas lines. The V. D. Anderson Co.

117 On Glass Lined Tubing — Report 3954, on glass lined process tubing, provides information on joints, suitable base metals, glass coatings utilized. Also traces development of this tubing and discusses its possibilities in low cost, medium resistance applications. Gives general specifications and tells limitations of this tubing, stressing that it should not be used to replace heavy duty glass lined pipe. Barrows Porcelain Enamel Co.

MECHANICAL POWER TRANSMISSION

118 Scale Drawings for Power Drives — Now available to power engineers is a folder containing a set of scale drawings for company's geared Slo-Speed electric power drives. The templets are convenient in layouts and provide accurate clearance information quickly. In all, 22 sheets are included, and three views of each drive are detailed and type drawn to three separate scales. Ratings from ½ to 30 hp are covered, and the drawings are adaptable to most drafting requirements. Sterling Electric Motors, Inc.

The new and revised publications reviewed on these pages offer help on many operating and maintenance problems. To order them, use the Reader Service Cards on pages 105–106

119 How to Figure Hp of V-Belt Drive — Interim Bulletin 20B6956B, 6 pp, presents condensation of new method of calculating hp capacity of standard and high-capacity "Texrope" V-belt drives. Takes into consideration effect of belt length, ration of diameters of driving and driven sheaves on hp rating of the belt. Allis-Chalmers Mfg. Co.

120 Chain Drives — Catalog 154, 20 pp, explains operating characteristics, service factors of manufacturer's pre-selected drives; how to select the proper drive; lubrication and maintenance. Tables give specifications, prices, horsepower capacities. The Ramsey Chain Co., Inc.

BOILERS AND AUXILIARIES

121 Packaged Steam Generator — Bulletin BE3, describing oil or gas fired

automatic boiler in sizes from 20 to 50 hp, stresses advantages of the unit's two-pass system with forced draft. A large cutaway illustration shows design details and component parts are discussed in detail. Continental Boiler Div., Boiler Engineering & Supply Co., Inc.

122 Packaged Boilers — This new bulletin describes packaged boilers in sizes to 500 hp, pressures to 250 psi, which are particularly suited for school installations. Discusses construction details, gives ratings and dimensional data and explains their advantages for use in steam process as well as steam and hot water heating service as applied to schools. Some installations are pictured. Orr & Sembower, Inc.

123 Boiler-Burner Unit — Catalog 502, 16 pp, gives detailed description of Kewanee-Petro boiler burner unit for either gas, oil, or gas and oil firing, for high or low pressure operation. Illustrated in full color, covers ratings, dimension, data, supplemental equipment; discusses thermal viscosity. Kewanee-Ross Corp.

124 Entrainment Burners — Bulletin H-64 covers manufacturer's piloted entrainment burners for forging, heat-treating and boiler firing. Illustrated with diagrams and charts, gives construction details. Eclipse Fuel Engineering Co.

125 To Cut Boiler Plant Costs — Savings in plant fuel and labor costs by use of continuous boiler blowoff heat recovery equipment is discussed in 8-pp Bulletin WC-114. Two pages of charts, curves and calculations show how to compute savings in Btu per year. Flow diagrams illustrate such type systems as flash and non-flash, single and double flash tank, and combination flash-deaerator. Lists accepted American Boiler and affiliated Industries standards for total dissolved solids and suggested silica concentrations in boiler system blowoff accessories. Graver Water Conditioning Co.

. . . *Outstanding Among This Month's Catalogs*

126 Fittings, Piping Handbook — Catalog 55 is a 304-pp general handbook providing dimensional data and specifications on seamless welding pipe fittings, forged ASA flanges, large diameter and TEMA flanges, as well as screwed and socket welding fittings. Includes a technical data section featuring new, easy-to-use allowable stress and P/8 tables, maximum allowable working pressure charts, as well as other tables covering latest provisions of applicable piping codes and standards to assist in solving piping problems. Book is well illustrated, fully indexed, has stiff binding. It is available to qualified power engineers, please state your job title when requesting it. Ladish Co.

127 Instruments Ordering Guide — Catalog 54 is a 190-pp illustrated book covering industrial, electrical and electronic meters, controls and test equipment. Covers bridges and recording instruments; panel and switchboard instruments; pyrometers and thermometers; service instruments; timers and photoelectric controls, transformers, voltage regulators, rectifiers; switches, solenoids and solenoid valves, others. Book is arranged for easy ordering. Electro-Tech Equipment Co.

HEATERS AND HEATING

128 Tubular Electric Heaters — Bulletin 202 describes, illustrates the five component parts of company's tubular electric heaters. Explains characteristics of electric heating and operating comparisons with steam. Turbine Equipment Co., Hynes Electric Heating Div.

129 Induction Heat — Bulletin GEA-5983, 8 pp, outlines benefits of induction heat in the forging industry. Includes case histories of on-the-job applications. Provides frequency-time-work diameter charts to aid in determining power requirements. General Electric Co.

130 Heat Transfer Equipment — Eight-pp Bulletin F. 600-2 explains that company's heat transfer equipment is tailored for individual performance specifications in heating, cooling of corrosive or non-corrosive liquids and gases. Illustrates different types and unit combinations. Industrial Filter & Pump Mfg. Co.

131 Electric Oil Heaters — Catalog 709A, gives capacity ratings of manufacturer's electric oil heaters for sizes from 2 up to and including 64 kw. Discusses automatic operation, finned tube heating element, company's electric oil preheater. Hauck Mfg. Co.

INSTRUMENTS AND CONTROLS

132 Instrumentation in Action — Included in the 48-pp recent quarterly issue of this company's Instrumentation are articles on controlling fuel to open hearths, control of recirculated cooling water quality, and the production and finishing of beryllium copper. Also describes the central monitoring of 119 temperatures in an air-conditioned building. Industrial Div., Minneapolis-Honeywell Regulator Co.

133 Control Centers — Advantages of control centers and their versatility are discussed in this 28-pp booklet. Generously illustrated with photos and full-color drawing, booklet shows 10 typical installations of control centers and explains how this equipment can lower costs. Design and construction features are explained, and three basic NEMA types of construction described. Electrical and mechanical construction details are shown, typical specifications included, also handy space requirement tables. The Clark Controller Co.

134 Points on Pyrometry — Bulletin 4371 stresses economy and precision of thermoelectric pyrometer for temperature measurement beyond 1000 F. Discusses line of Alnor pyrometers designed for different temperature-reading problems. Illinois Testing Laboratories, Inc.

135 Controls, Resistors — Catalog 54, 24 pp, covers company's industrial controls, as well as controls and resistors for radio and electronic equipment. Illustrated with photos and dimensional drawings, catalog gives full ordering data, prices and packaging information. Clarostat Mfg. Co., Inc.

136 Level Control — Bulletin A, 6 pp, introduces a floatless electronic type level control with accuracy and performance said to be unaffected by pressure temperature, acids or salts. Contact with the liquid is made by a stainless steel probe. Bulletin gives specifications for probes and fittings, application suggestions. Also gives data on a floatless magnetic type liquid level control. Ferrara Inc.

Easiest way to order the bulletins you need is to use one of the postage-free Reader Service Cards on pages 105 and 106. Just circle the item numbers of all those you would like to receive.

137 Resistance Thermometer Bulbs — Sixteen-pp Catalog 5701 describes resistance thermometer bulbs of high speed, room temperature, sanitary and other types for temperature spans as narrow as 20 F. Also included are wet and dry bulb resistance thermometer assemblies for measurement of relative humidity. Industrial Div., Minneapolis-Honeywell Regulator Co.

138 Boiler Feed Control — Bulletin 1003, a 12-pp catalog on boiler feed regulators is illustrated with large application photos and detailed schematic drawings and charts. Relay and direct operation are covered. Case studies of representative boiler loads are presented to show stability of the Flowmatics in controlling feed water automatically according to steam flow. Copes-Vulcan Div., Continental Foundry & Machine Co.

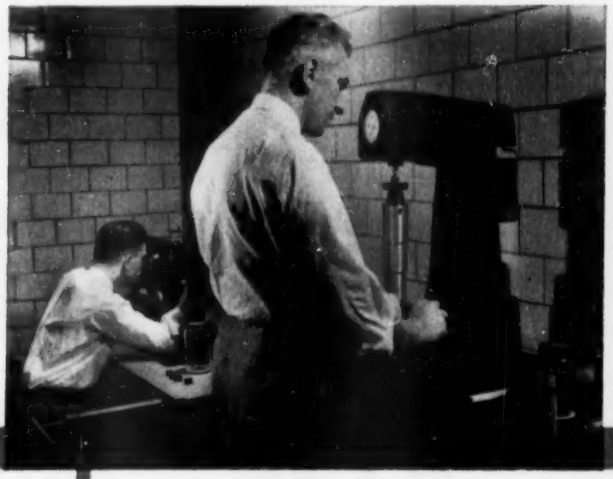
139 Combustion Control Case History — Bulletin R-10, 8 pp, presents an account of a salt manufacturer's "exposed" steam generator, featuring air flow-steam flow compensated combustion control. Shows how this semi-outdoor boiler handles load swings up to 80,000 lb per hr at 85 per cent efficiency. The Hays Corp.

140 Transmitter Unit — Bulletin 9563M describes and illustrates a pneumatic signal transmitter for use with company's ring balance meter. Using a schematic diagram of the operating mechanism, booklet explains how speed, accuracy and stability of the transmitter, in combination with the ring balance meter, provides an instrument adaptable to a wide variety of metering and control applications. Hagan Corp.

141 Remote Level Indicators — Twenty-pp Bulletin WG-1824 contains a complete description of the Yarway remote liquid level indicator. Also gives helpful application, installation and operational information. Photos show typical installations of these indicators on boiler room panels, and wiring diagrams are included. Yarnall-Waring Co.

142 Portable Temperature Indicators — Bulletin A-303-1, 8 pp, describes company's potentiometer indicator and resistance thermometer — portable temperature indicators for periodic spot checks of heating units and test furnaces. Describes operating adjustments, test circuits, specifications. Lists standard scales available, covering temperatures from

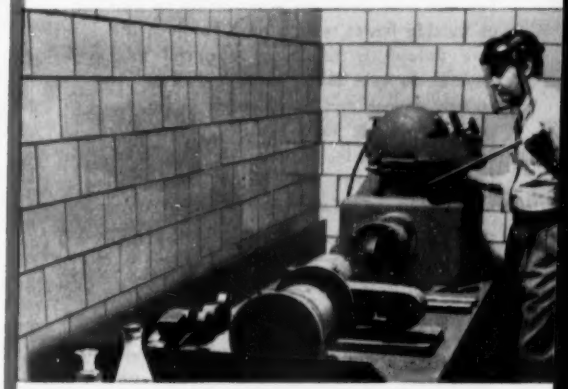
Heat-treating and physical testing equipment shown at left is used for quality control of welding operators and for development of new welding procedures.



This Rockwell hardness testing machine measures the hardness of weld specimens as a guide to proper procedures for heat-treating of welds.

Daily rigid testing is your insurance of quality welds in

NAVCO FABRICATED PIPING



A laboratory technician cuts a sample from a pipe weld prior to grinding and polishing for metallographic examination.

At Navco, a continuous parade of weld specimens are processed in the new, modern physical-chemical testing laboratory. It is here that weldments are studied metallographically and tested physically—all on a rigid schedule of quality control practices. Navco customers have benefited from progressive quality control practices for more than 40 years; they have come to know that piping installations, engineered, fabricated and erected by Navco, are precise, accurate and dependable.

Call on NAVCO for your next piping job.

Here a weld specimen is etched to outline the grain structure for further metallographic study.

NATIONAL VALVE & MANUFACTURING COMPANY

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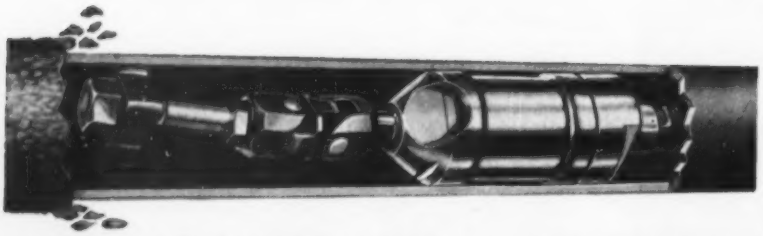


ROTOJET®

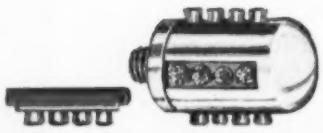
Cleans Fire Tubes ▸▸▸▸▸▸ FAST ▸▸▸▸▸▸▸ INSIDE and OUTSIDE

You can now clean fire tubes inside as well as outside faster with a new Rotojet. The new Rotojet is the most powerful tube cleaner we ever built. It won't stall at low speeds caused by heavy loads. Roto expanding heads and brushes thoroughly clean soot scale inside tubes. A Roto vibrating head (illustrated above) knocks off water scale adhering on the outside.

Try the new Rotojet, and no other tube cleaner will ever satisfy you.

Economical Roto Brushes

Roto expanding brushes and heads have separately replaceable wearing elements. These inexpensive parts save time, money, and critical materials. Send for details.



Roto expanding brush, showing a replaceable brush element. Brings down tube cleaning cost. Maintains high cleaning efficiency.

Roto solid wire brush.

Model SS2S ROTOJET Air-driven Motor with swing-frame head for 3" O.D. tubes.

Model SS0S ROTOJET Air-driven Motor with 2-arm head for 2" O.D. tubes.

ELLIOTT COMPANY-ROTO DIVISION

147 Sussex Ave. Newark 1, N. J.

—200 to 2800 F: type of thermocouple or resistance bulb for each range, degrees of temperature indicated by each scale division. The Foxboro Co.

143 Gage Glasses — Pyrex and Corning gage glasses, their dimensions and tolerances, recommended maximum working pressures, are discussed in Bulletin EG-1. Explains how to cut odd lengths of tubular gage glasses and how to install them. Technical Products Div., Corning Glass Works.

SOUND, VIBRATION CONTROL

144 Engine Vibration Control — On-the-job photos and case histories showing how diesel and gas engine vibration problems have been solved are presented in Catalog PS-4. Gives advantages of company's vibration control units; also tells how to select proper isolating medium for the installation, discussing applications for steel spring isolators, rubber and cork. The Korfund Co., Inc.

145 Shock, Vibration Isolators — Product Bulletin 538 describes isolators designed to reduce shock and noise caused by impact-type machines, vibration, noise of heavy rotating and reciprocating machinery. Discusses dimensions and loads, installation procedures, variation of natural frequency with load, per cent isolation of vibration for various frequencies and applied loads. The Barry Corp.

146 Applied Quiet — This folder describes Hushmush, a sound deadening and vibration dampening material in types for spray-on or wipe-on application. Stresses economy, fast drying, fire resistance and other advantages of the material. Gives drying time and coverage, also application recommendations and tips on finishing and painting. The Philip Carey Mfg. Co.

AIR CONDITIONING

147 Package Air Conditioner — Bulletin C-1100-B49, 12 pp, introduces company's new package conditioner for commercial and other applications. Illustrates two models, giving dimensions and capacities. Stresses such advantages as three-dimensional air circulation, winter climate control, versatile air discharge. Worthington Corp.

148 Air Conditioning-Refrigeration Equipment — Bulletin W-2-S, Section M, 12 pp, describes company's line of Dependable valves, filters and driers, as well as product specifications, charts, selection and sales data. Illustrates new products and includes model number changes. A-P Controls Corp.

METALS

149 Engineering Properties of "S" Monel — This 7-pp technical booklet gives the engineering properties of "S" Monel, an age-hardenable casting alloy providing strength, hardness and anti-galling properties at temperatures up to 1100 F, in addition to the general corrosive resistance of Monel. Nine tables give listing composition, physical constants, mechanical and compressive properties, speeds for machining casting materials. The International Nickel Co., Inc.

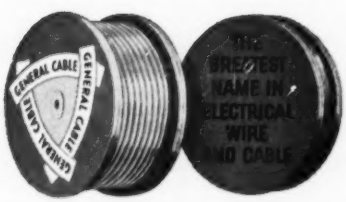
150 Metal in Chemical Processing — Form SS-11, 34-pp, covers use of stainless steel in manufacture of acids and other chemicals, in the general process industries, plastics, pharmaceutical manufacture, soap and dye making. Includes corrosion re-

GENERAL CABLE

THE GREATEST NAME IN ELECTRICAL WIRE AND CABLE

For the Answers to Your Wiring Problems . . .

ASK THE MEN WHO KNOW



BARE, WEATHERPROOF, INSULATED WIRES
and CABLES FOR EVERY ELECTRICAL PURPOSE

At General Cable our engineers devote themselves as much to customers' wire and cable problems as they do to the design and manufacture of the products you buy.

We would like you to think about this engineering service next time you face a wire or cable problem.

You see, our engineering staff is recognized as one of the industry's most authoritative groups of its kind. Ready at any time... to go anywhere, General Cable engineers can assist you in the solution of any electrical wire or cable problem... can quickly recommend and provide the most practical product for the job at the least possible cost.

So—on any problem—transmission, distribution, power, control, lighting, or electrical equipment, check General Cable first. You'll be dealing with the men who know.

GENERAL CABLE CORPORATION 420 Lexington Avenue, New York 17, New York

Sales Offices: Atlanta • Buffalo • Cambridge (Mass.) • Chicago • Cleveland • Dallas • Detroit • Greensboro (N. C.) • Houston Indianapolis • Kansas City • Los Angeles • Milwaukee • Minneapolis • New York • Newark (N. J.) • Philadelphia • Pittsburgh • Portland (Ore.) • Rome, N.Y. • Rossmoyne, O. (Cincinnati area) • St. Louis • San Francisco • Seattle • Syracuse • Tulsa • Washington, D. C.

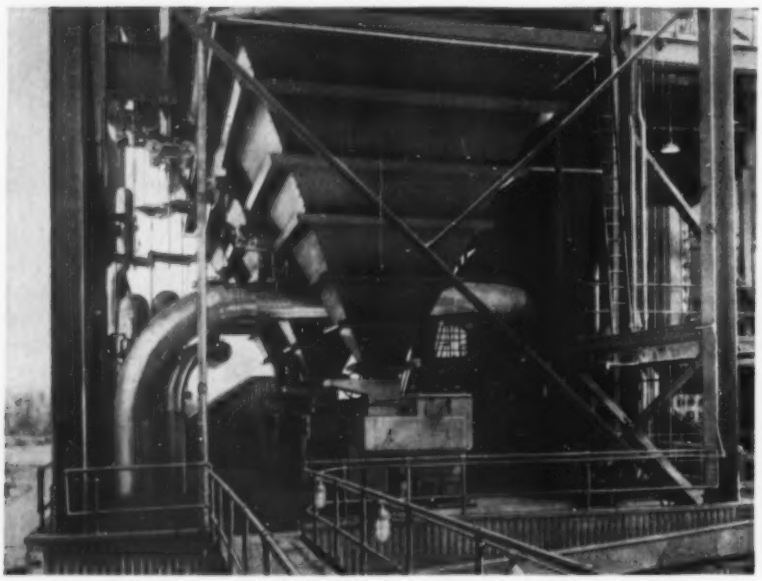
For more data circle 520 on Post Card

Carolina Power & Light

again specifies

Richardson

Richardson Automatic Coal Scales are playing a vital part in helping supply power for the new Industrial South. Here are Richardson Model 39's in an outdoor installation at the new generating station of Carolina Power and Light.



To both industrial and utility power generating stations, specifying Richardson means—

1. A 24" x 24" inlet opening and 26" wide belt for maximum coal flowability.
2. All wiring and controls outside coal chamber.
3. Access doors which will not spill dust on floor when opened.
4. Beam ratio test facilities outside coal chamber.
5. Gravity operated by-pass, with no restriction of coal flow to downspout.
6. No drag links or wires attached to weigh hopper.
7. Nationwide after-delivery service.

Latest development in the 39 Series of Richardson Automatic Coal Scales is the Model H-39 shown below. May we send you our new 16-page engineering data book on the H-39 Coal Scale (Bulletin 0352), without cost or obligation?

RICHARDSON SCALE COMPANY · Clifton, New Jersey

Atlanta • Buffalo • Boston • Chicago • Detroit • Houston
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0761

Richardson

MATERIALS HANDLING BY WEIGHT SINCE 1902

sistance data, fabricating information, and a stainless steel finder giving comparative properties of 13 metal types. Allegheny Ludlum Steel Corp.

151 High Temp Tubing Steel — An alloy tubing steel widely used in elevated temperature service where high corrosion resistance is desirable is discussed in Technical Data Card TDC 151. Includes data on mechanical and physical properties, bending, welding, and heat treatment of this metal, company's Croloy 9M (8 to 10 per cent chromium, 1 per cent molybdenum). Tubular Products Div., The Babcock & Wilcox Co.

152 Heat Exchanger, Condenser Tubing — Bulletin TB-329A provides analyses and mechanical properties of 29 carbon, alloy and stainless tubing steels for various heat exchangers and condensers. Tables give reference specifications and application information. Tubular Products Div. The Babcock & Wilcox Co.

OTHER EQUIPMENT

153 Sound Products — Form 2R-8348 (rev.) is a 20-pp catalog listing manufacturer's sound equipment. It is divided into sections dealing with microphones, amplifiers, speakers, intercommunication equipment etc., designed to meet needs from portable systems to large sound installations. Descriptions of each model include information on special features, uses, specifications and photos. Sound Products Section, Radio Corp. of America.

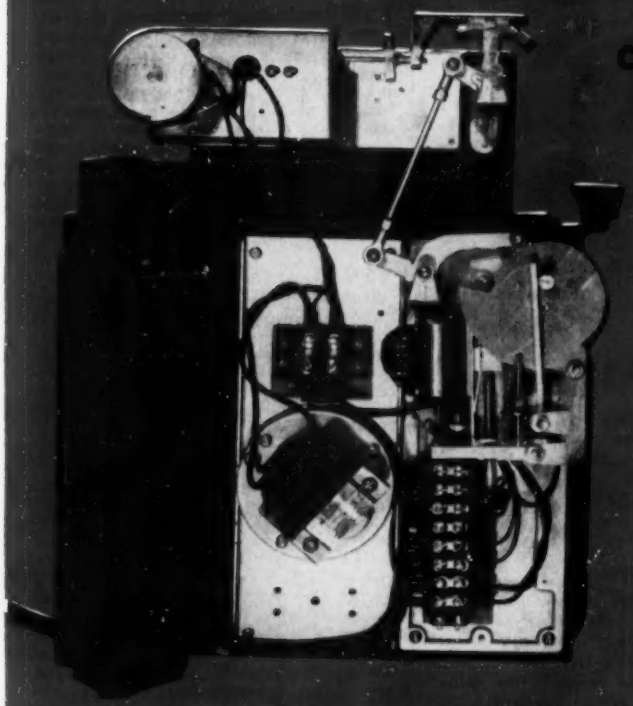
154 Handbook on Crushing — Not an ordering catalog, this 32-pp manual is aimed at a better understanding of mechanical crushing in order to promote better results from crushing operations. Well illustrated, booklet stresses importance of suiting the crusher to the job. Four means of mechanical reduction — impact, attrition, shear and pressure — are discussed in detail. Also included is information on power requirements of crushing, and selection factors, also a materials index table. Hammermills, impactors, single rolls, jaw crushers, and other crushers are covered in detail. Pennsylvania Crusher Co.

Postage-free cards for ordering catalogs are on pages 105–106. You may also use the cards to ask for further information on the advertised products.

155 Improved Trainee Testing — A new method for training and testing proficiency of personnel to service electronic equipment is shown in 6-pp Form X-16. Explains how method utilizes printed forms, rather than actual equipment, to check on a man's understanding of the problem and its solution. Tells how the system cuts costs, teaches circuit tracing, gives experience in troubleshooting; also how it simplifies training, and is adaptable to many training situations. Van Valkenburgh, Nooger and Neville, Inc.

156 Water Treating — Booklet 500 describes manufacturer's three-stage reactors for softening, clarifying surface waters and in treating waste water for re-use or reduction of stream pollution. Lists uses including all precipitation and absorption processes involving cold water; water soft-

a new electronic flow meter!



Choice of 3 mercury-less transmitters

Hays Barton flow or differential transmitter

Hays differential transmitter

Hays liquid level transmitter

continuous integration —no creep at zero

unaffected by normal voltage; frequency and temperature changes

electronic operation provides high speed and greater accuracy

3 to 1 range calibration at recorder

HAYS Electronic Flow Meter

Since the circuit is of the electronic null-balance type, it is unaffected by normal voltage and frequency variations. Also, neither temperature variations nor reasonable length of transmission lines affect the calibration of the instrument.

The *pen-drive motor* is built for reversing duty. Normal variations in voltage and frequency have no noticeable effect on its operation.

The *integrator* is continuous in operation and simple in mechanical construction. A micrometer zero adjustment for calibration is easily accessible.

Indicators can be calibrated to read directly in rate-of-flow or other factors as desired.

Write today for full information on the Hays Electronic Flow Meter Bulletin 52-1074-222.

Automatic Combustion Control
Boiler Panels
Veriflow Meters and Veritrol
Gas Analyzers • Draft Gages
Combustion Test Sets • CO_2 Recorders
Electronic Oxygen Recorders
Electronic Flowmeters
Electronic Feed Water Controls
Miniature Remote Indicators

THE hays CORPORATION

MICHIGAN CITY 7 INDIANA

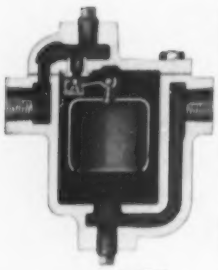
For more data circle 522 on Post Card

DOUBLE DRAINAGE

AT LOWER COST WITH

DUO-STEP Traps

FAMOUS DUO-STEP LEVERAGE IS NOW AVAILABLE FOR THE FIRST TIME ON THESE SMALLER SIZED STEAM TRAPS. GET HIGHEST DRAINAGE CAPACITY AT LOWEST COST.



CLARK 60-D TRAP

CLARK 70-D TRAP

Duo-Step is the revolutionary double fulcrum principle that affords maximum leverage to "crack" the valve from the orifice seat, teamed with "Follow-through" power that opens the orifice completely. This double action actually gives you double the drainage capacity of ordinary steam traps.

MODEL 60-D traps are of cast semi-steel construction, designed for pressures up to 200 P. S. I. and temperatures to 400°F. Duo-Step levers and brackets of stainless steel construction. Seats and discs are of Clark-loy. ½" or ¾" horizontal inlet and outlet connections with ¼" test outlet and drain plug. Vertical inlet can be furnished in ½" or ¾" size.

MODEL 70-D traps are of cast semi-steel construction, designed for pressures up to 200 P. S. I. and temperatures to 400°F. All working parts of stainless steel construction. Seats and discs are of Clark-loy. Horizontal inlet and outlet connections located at bottom of trap body for close-to-the-floor installations.

MODEL 70-TD for pressures to 150 P. S. I. and temperatures to 375°F. is available WITH BUILT-IN THERMAL BY-PASS at additional cost.

FOR COMPLETE INFORMATION CONTACT YOUR CLARK REPRESENTATIVE OR WRITE FOR *NEW* DUO-STEP BROCHURE

HOME OF DUO-STEP LEVERAGE

Clark

MANUFACTURING COMPANY

1830 EAST 38th STREET

CLEVELAND 14, OHIO

Distributors and Representatives in all major cities

ening for municipal, industrial and process applications; dealkalization and coagulation of surface water. American Water Softener Co.

157 For Extreme Bearing Pressure Lubrication — Bulletin 101 covers Molykote Type BR-2, a multi-purpose extreme pressure lubricant, described as a lithium base product containing molybdenum disulfide powder. Lists 10 points of superiority for this lubricant and discusses factors responsible. Includes specifications, ordering data and prices. The Alpha Corp.

158 Dual-Fuel Engines — Bulletin S-500-B57, 36 pp, describes dual-fuel engines for rural generating stations, sewage disposal, private utility, municipal power, industrial power and other applications. Includes photos of each type of installation, along with statistics, case histories and comments on fuel consumption. Space is devoted to each feature — fuel injection pump, automatic fuel switcher, thermal air control, and the gas valve which controls fuel gas supply to individual power cylinders. Worthington Corp.

159 Weed Control — Low cost weed and grass control with "Telvar" W (formerly CMU) weed killer is discussed in Bulletin A-6644, 12 pp, full color. Illustrates some uses of this wettable powder at industrial plants, along railroad trestles, around electrical installations. Gives directions for application. E. I. du Pont de Nemours & Co.

160 Lagging Adhesives — Technical Bulletin 5307 describes Adhez-A-Kote lagging adhesives and coatings for shrinking, sizing, bonding and protecting insulation lagging fabrics. Outlines features of the product, pictures typical installations, and includes a sample of treated lagging fabric. Tips on proper application are included. General Paint Corp.

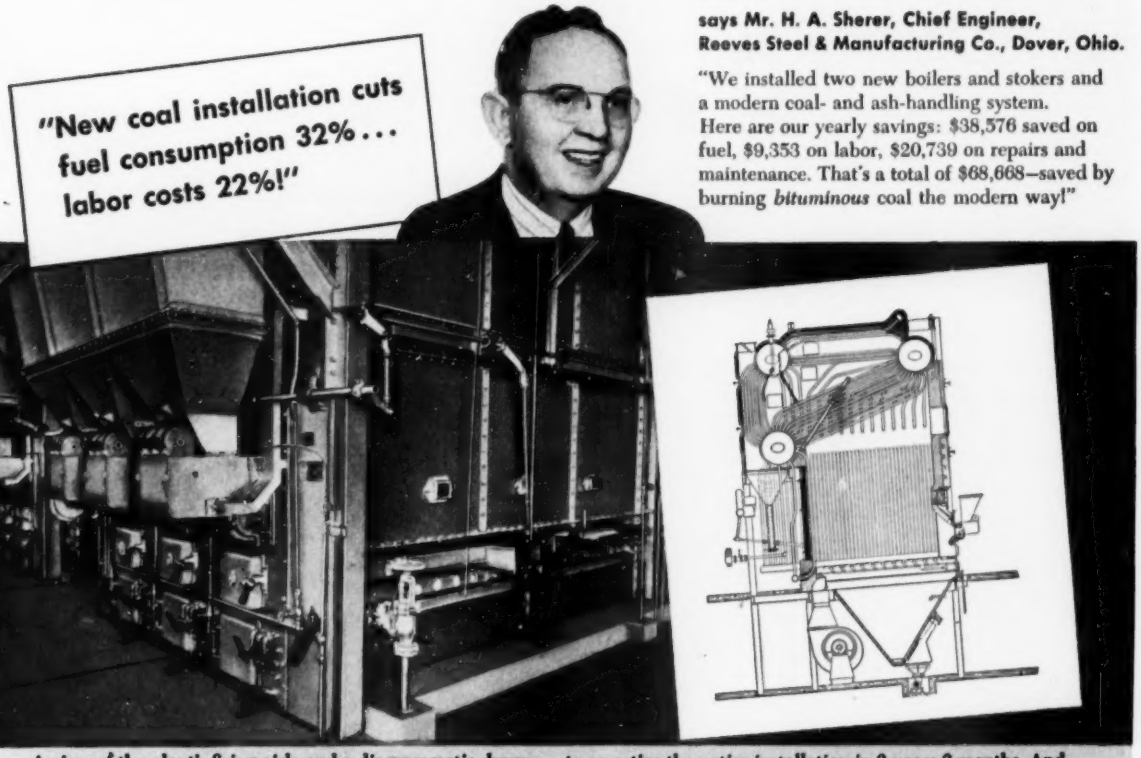
161 Rubber Linings — This attractive 8-pp bulletin describes the advantages, application of manufacturer's various rubber linings to steel tanks, drums, pipes, valves, fittings and pumps. Includes tables giving resistance characteristics of rubber lining to inorganic acids, salts and alkalies, organic materials. Protective Coatings Div., Metalweld, Inc.

162 Industrial Equipment — Bulletin WP-1099-B61, 16 pp, describes manufacturer's industrial equipment including centrifugal refrigeration, condensers and coolers, steam power plant equipment, water conditioning deaerators and rotary pumps. Gives features, types, sizes, capacities, and describes their application in various industries. Worthington Corp.

163 Repairing Conveyor, Elevator Belting — This 32-pp manual on how to splice and repair conveyor and elevator belting contains 42 photos showing step-by-step splicing procedures. Describes splicing materials, tools needed, methods for splicing cord and fabric belts. Gives instructions in on-the-job vulcanizing of splices with portable vulcanizers. Chart shows quantities of material needed for specified jobs; tables give correct splicing for different belt rubbers. The B. F. Goodrich Co.

164 Pneumatic Sewage Ejector — Packex, a packaged pneumatic ejector for low flows for use in small buildings and subdivision lift stations, is described in Leaflet 4420. Tables give fixture-unit rating, dimensions. Yeomans Brothers Co.

"WE SAVE OVER $68,000 A YEAR— BY BURNING COAL THE MODERN WAY!"



says Mr. H. A. Sherer, Chief Engineer, Reeves Steel & Manufacturing Co., Dover, Ohio.

"We installed two new boilers and stokers and a modern coal- and ash-handling system. Here are our yearly savings: $38,576 saved on fuel, $9,353 on labor, $20,739 on repairs and maintenance. That's a total of $68,668—saved by burning *bituminous* coal the modern way!"

A view of the plant's firing aisle and a diagrammatic drawing of one of the boilers. It now costs 18.8¢ less to generate every thousand lbs. of steam. This is a saving large enough to amortize the entire installation in 3 years-3 months. And that includes all the cost incurred in tearing out old equipment and constructing a new plant floor!

Today, *bituminous* coal's inherent economy has been greatly increased. Modern combustion installations give you more steam for every dollar . . . automatic coal- and ash-handling systems cut labor costs to a minimum.

A consulting engineer can show you how coal can do a better job—*and save you real money*—in a plant designed to meet your *specific* needs.

In addition, with coal you get the basic advantages of price stability, and dependable supply. These advantages are assured by America's virtually inexhaustible coal reserves and the high productivity of America's coal industry.

If you operate a steam plant, you can't afford to ignore these facts!

COAL in most places is today's lowest cost fuel.

COAL resources in America are adequate for all needs—*for hundreds of years to come.*

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

BITUMINOUS COAL INSTITUTE

A Department of National Coal Association, Washington, D. C.

FOR HIGH EFFICIENCY FOR LOW COST

YOU CAN COUNT ON COAL!

For more data circle 524 on Post Card

Here's Big-Capacity Coal Handling at its Economical Best

. . . using the ALLIS-CHALMERS HD-20 TRACTOR . . .

Big Volume — With a 175-hp. diesel engine and weighing over 20 tons, the Allis-Chalmers HD-20 Tractor has plenty of weight and power to handle coal in large quantities — dozes 14 tons at a pass with special coal blade, carries or loads 5 tons at a time with tractor shovel, pulls a scraper capable of hauling 18 tons or more.

Economical Coal Handling — Storing and reclaiming coal with Allis-Chalmers Tractors is considerably more economical and flexible than with complex conveyor or crane systems — both in first cost and in operation. The tractor method of handling coal permits keeping equipment in-

Moves Coal and Compacts It

This Allis-Chalmers HD-20 dozes coal out onto a stockpile at a southern power plant, compacting it at the same time to avoid fire by spontaneous combustion. Two of these tractors purchased in 1950 proved so successful that the utility now has eight working in three plants.

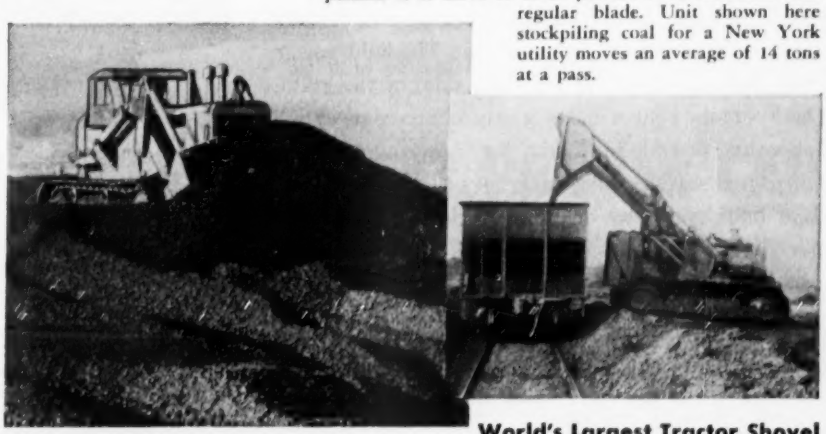
vestment in close balance with current operating needs. More tractors can be added as demand increases — storage areas can be abandoned without leaving money tied up in idle equipment.

Dependable, Easy Operation — The HD-20 is a *modern* tractor, designed to meet today's requirements. One-piece, welded main frame, forming a continuous, strong backbone typifies its construction to stand the gaff of daily use for years. Hydraulic control permits steering with the touch of a finger. Lubrication of final drives, truck wheels and idlers lasts 1,000 hours to save both grease and time. Unit construction simplifies servicing, puts tractors back to work sooner. Hydraulic torque converter drive eliminates most shifting, avoids shock to tractor and Allied equipment, thus lengthening service life.

Coal Stockpiled Anywhere with Tractor-Scraper Team — Coal brought in by water to Midwest chemical plant is economically hauled to stockpile, spread in 4-in. layers and compacted by Allis-Chalmers HD-20 Tractor and scraper carrying 18 tons. Storage areas can be placed wherever space is available, coal piled high if space is limited.

Special Coal-Handling Blade is designed to take full advantage of the HD-20's big 175 net engine hp., permits it to move 15 to 20 percent more coal than with regular blade. Unit shown here stockpiling coal for a New York utility moves an average of 14 tons at a pass.

Find out more about how the HD-20 or three smaller Allis-Chalmers tractors can improve coal handling for *you*. Your dealer will be glad to demonstrate right at your plant. Also send for free booklet, "Economic Coal Storage with Allis-Chalmers Tractors."

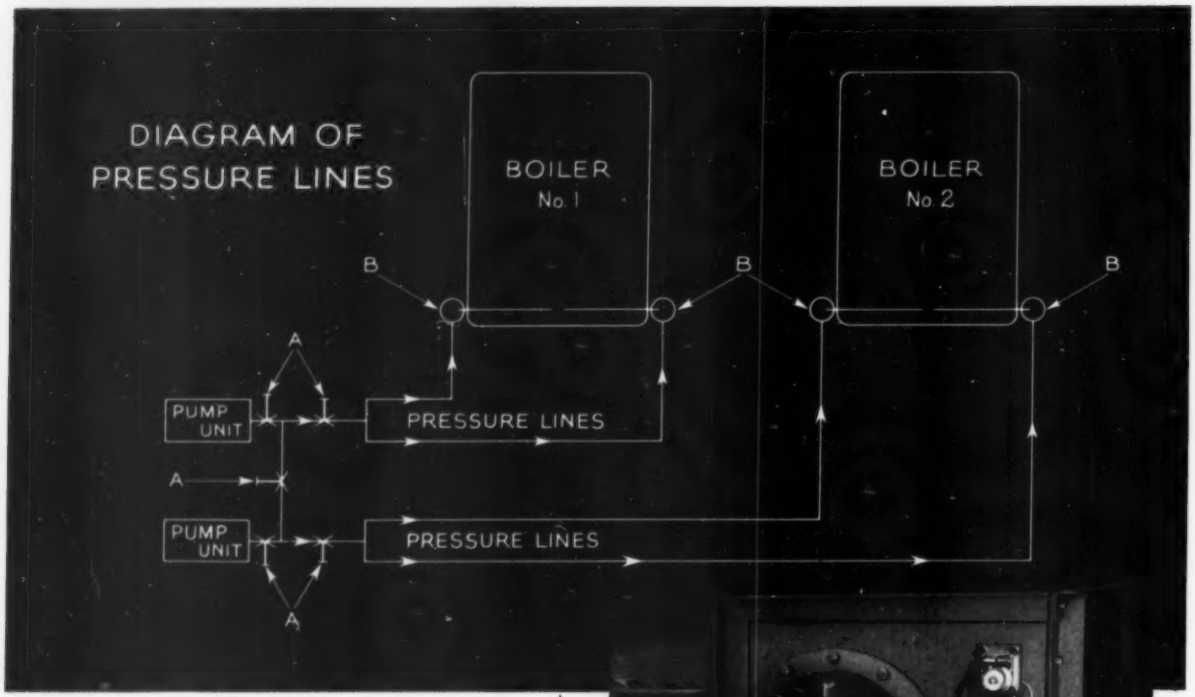


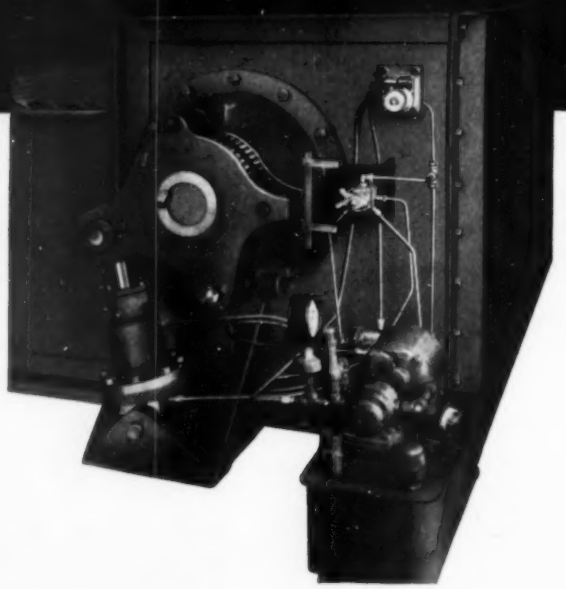
World's Largest Tractor Shovel Pushes Coal or Loads it — Allis-Chalmers HD-20G with 7-yd. bucket is a big-production unit for moving coal to stockpile and then reclaiming it as needed (left above). It is a big-production loader, too (right above). Five-ton capacity and 13-ft. dumping height make it ideal for loading hoppers, cars, biggest trucks.

ALLIS-CHALMERS
TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

For more data circle 525 on Post Card

PERFECT SPREAD STOKER





permits hydraulic
dual grate drive
for maximum dependability

ALL Continuous Ash Discharge Perfect Spread Stokers can be driven by a single power unit. The fluid power pump feeds cylinders "B" on both sides of the grate. This hydraulic system makes it easy to interconnect two stokers and provide for *dual drive* . . . assurance of uninterrupted service in an emergency as one pump will drive both grates by opening or closing valves "A" (See diagram).

In addition, the AE hydraulic drive assures smooth operation, requires less power and maintenance, and gives an infinite choice of speeds from zero to maximum. Automatic overload protection built in. Complicated and aisle-blocking reduction gears are eliminated. The pumping unit can be located next to the stoker or at any convenient place in boiler room or basement.

Write for full information about the AE Perfect Spread . . : the stoker that provides true, continuous feeding of 50 to 7500 lbs. of coal per hour per feeder and never clogs, *not even on wet coal.*

AMERICAN ENGINEERING
COMPANY
2408 ARAMINGO AVE., PHILADELPHIA 25, PA.
IN CANADA: AFFILIATED ENGINEERING CORPORATIONS, LTD., MONTREAL 2, CANADA
AE Products are: Taylor and Perfect Spread Stokers, Marine Deck Auxiliaries, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists, Lo-Hed Car Pullers.

For more data circle 526 on Post Card

YOU CAN'T SEE WASTE HEAT!

CONTROL OF EXCESS AIR BY CITIES SERVICE HEAT PROVER CAN REDUCE HEAT LOSSES AT CEMENT PLANTS! In cement kilns, air must be controlled to the precise quantity that will just completely burn the fuel. Any excess of air above this amount carries waste heat out of the kiln. THE HEAT PROVER ENABLES THE OPERATOR TO SEE WHEN THE RIGHT AMOUNT OF AIR IS ENTERING THE KILN.

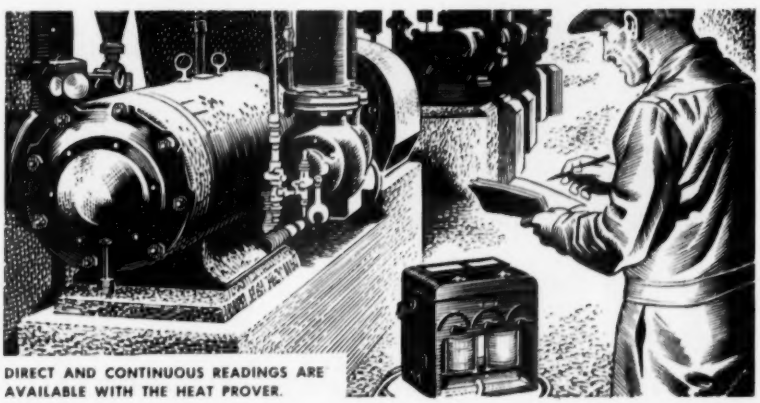
Many air-measuring methods allow only intermittent sampling of kiln gases. With the Heat Prover, direct and continuous readings of kiln combustion are available for immediate use . . . and the Heat Prover can bring about a considerable fuel savings and can substantially increase just about any cement plant's operating efficiency.

WHEREVER A FURNACE OPERATION IS INVOLVED the Heat Prover can help increase productivity and decrease operating costs. It samples rapidly and provides simultaneous and continuous readings of oxygen and combustible gases. The Heat Prover is portable—a technically accurate combustion analysis is obtained in a usable, practical manner. For details call your nearest Cities Service Office or write Cities Service Oil Co., Sixty Wall Tower, New York 5, N. Y.

BUT THE CITIES SERVICE HEAT PROVER CAN!

CITIES SERVICE

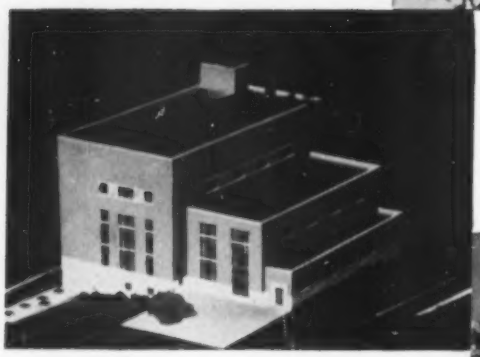
QUALITY PETROLEUM PRODUCTS

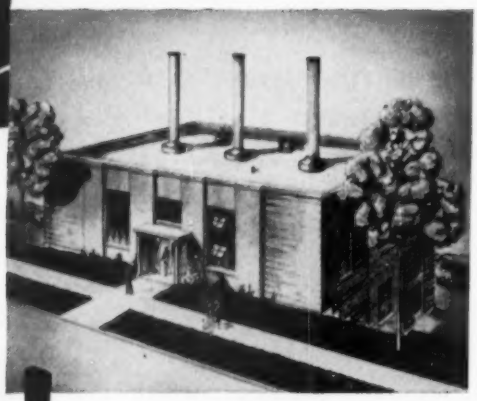


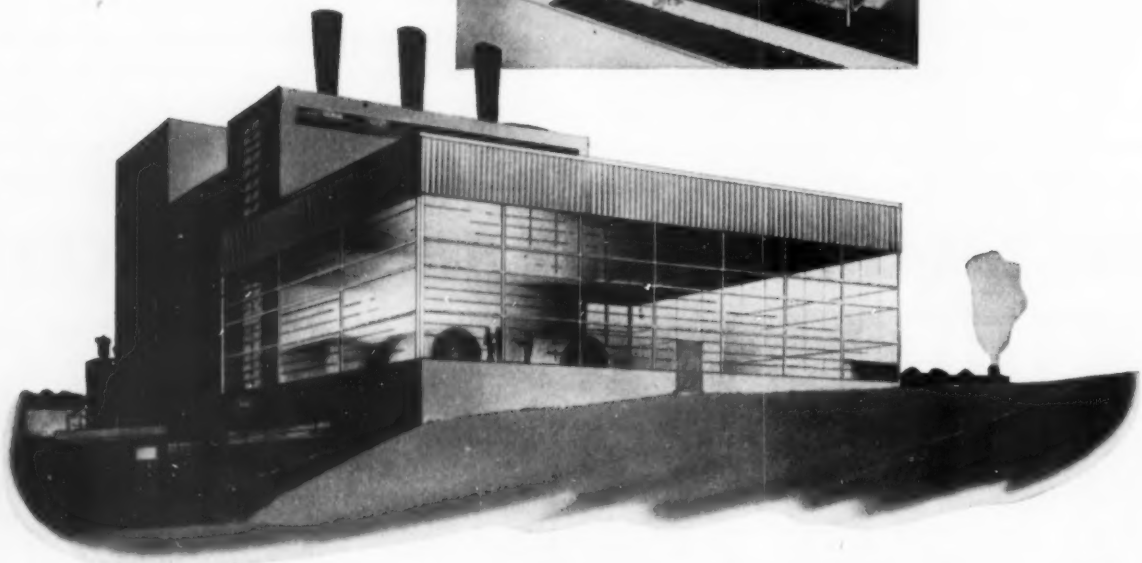
DIRECT AND CONTINUOUS READINGS ARE AVAILABLE WITH THE HEAT PROVER.

For more data circle 527 on Post Card

PROVED IN AMERICA'S







THE WICKES BOILER CO.

DIVISION OF THE WICKES CORPORATION, SAGINAW, MICHIGAN

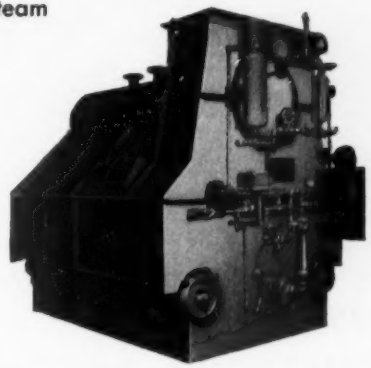
POWERHOUSES SINCE 1854

WICKES

STEAM GENERATORS

You'll find the real proof of WICKES' years of experience in the powerhouses across the nation . . . in the foundries and factories, the public utilities, the refineries and natural gasoline plants, in the schools, hospitals and other public buildings that depend on steam for low-cost heat and power. Wickes supplies steam generating equipment to thousands of industries and institutions.

WICKES will design and build water tube steam generators for any practical size and pressure. Wickes also offers a wide choice of auxiliary equipment so that it's possible for you to get not only the best steam generator but also the best correlated equipment. Contact your nearest Wickes sales representative or write us today.



153

RECOGNIZED QUALITY SINCE 1854 • **SALES OFFICES: Albuquerque, N. M. • Boston • Buffalo • Charlotte, N. C. • Chicago • Cleveland • Dallas • Denver • Detroit • Fort Wayne, Ind. • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City • Portland, Ore. • Saginaw • Salt Lake City • San Francisco • Springfield, Ill. • Tampa, Fla. • Tulsa • Washington, D. C.**

For more data circle 536 on Post Card

Important SUPERCHARGED

Here's what operation-proved A-C development can do for you now, and in the near future

BY CUTTING GENERATOR SIZE, *supercharged* cooling permits you to reduce plant size, lower foundation and crane costs, and use smaller breakers and bus structures. Mechanical design limitations are minimized, while possible maximum ratings are raised, and field assembly problems are simplified.

Two of the *supercharged* units now in operation are shown in the accompanying photographs. The installed units and others in various stages of production utilize direct rotor conductor cooling with high-velocity hydrogen to increase the generator rating more than 70% over conventional hydrogen cooling. Backed by experience gained from the first *supercharged* units, Allis-Chalmers is now building a *completely supercharged* generator resulting in the remarkable size reduction shown on the facing page.

For basic design information and a more detailed explanation of the many advantages of this outstanding engineering development, ask your A-C representative for the latest literature on *supercharged* cooling. Or, write to Allis-Chalmers, Milwaukee 1, Wisconsin. A-4251

World's First Supercharged Unit

Installed at Wisconsin Power and Light Company's Edgewater Station in 1951, this 60,000-kw turbine-generator unit has proved the soundness of Allis-Chalmers pioneering engineering. Its excellent performance during the first two calendar years of commercial operation *(1952 and 1953)* can be summarized as follows:

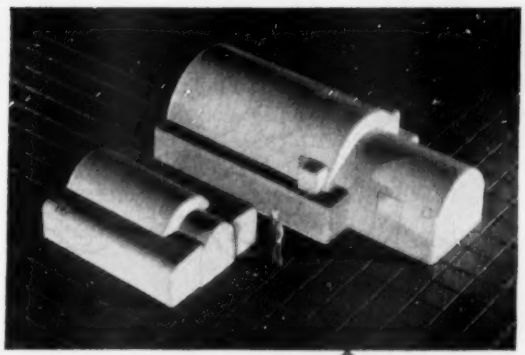
Hours in service	17,199
Service factor	98.03%
Chargeable outages	one
Availability factor	99.86%
Total generation	885,951,000 kw-hrs

Another unit, with a *supercharged* generator but incorporating new Allis-Chalmers steam turbine design features, was placed in operation early this year at Wisconsin Power and Light Company's Rock River Station.

ALLIS-

Facts About Cooling

ANOTHER *supercharged* unit — at the Dixon Station of Commonwealth Edison Company's Public Service Company Division. On the line since late summer of 1953, this 60,000-kw turbine-generator unit was placed in commercial service a few days after the initial start.



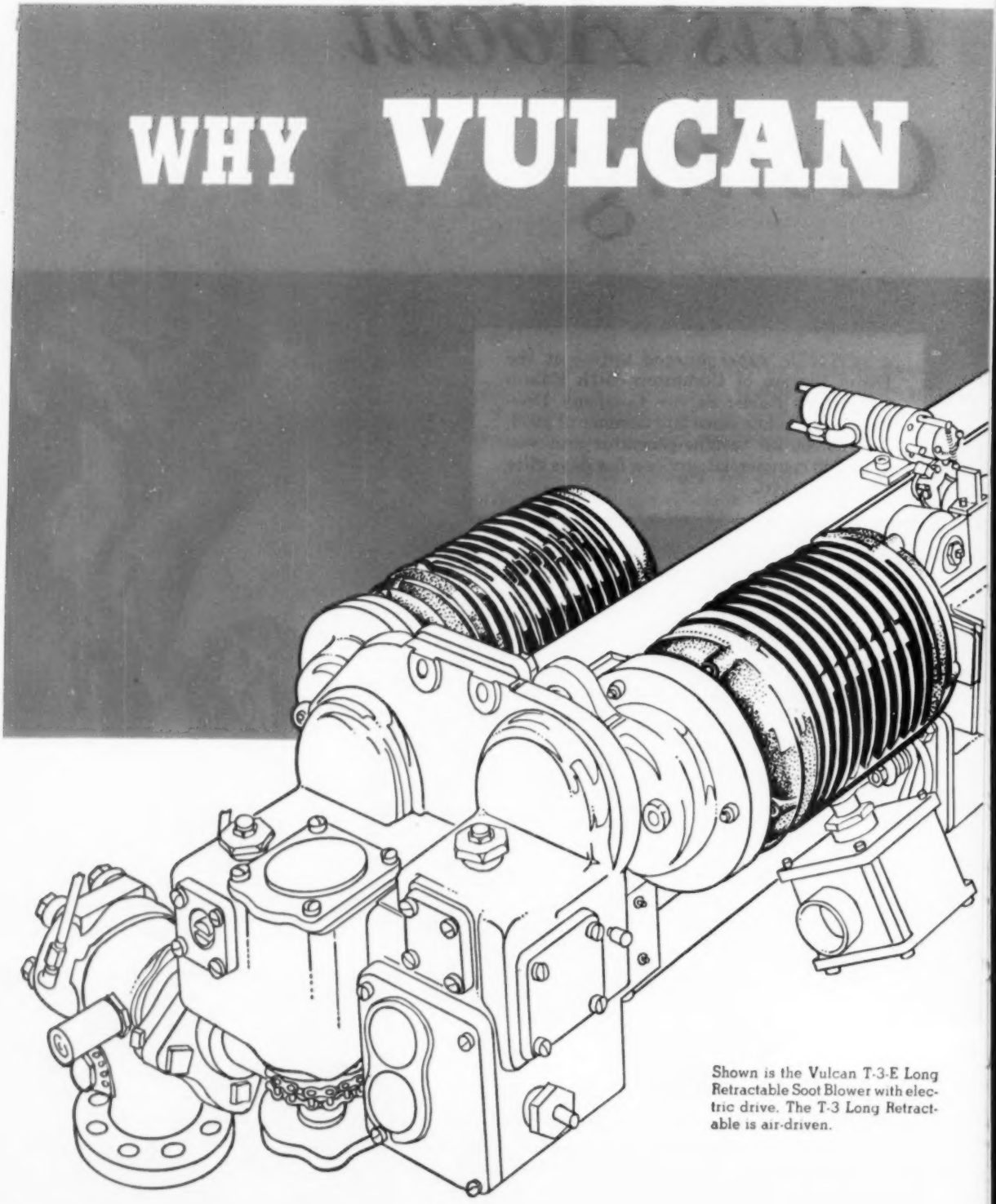
GREAT difference in size of *fully supercharged* and standard hydrogen-cooled generators of same kw rating suggests the increased advantages full supercharging offers in power plant space, crane capacity, quantity of gas, cooling water requirements, differential expansion, shipping clearances, and many other first-cost and operating factors.

CHALMERS

A-C ALLIS-CHALMERS

For more data circle 529 on Post Card

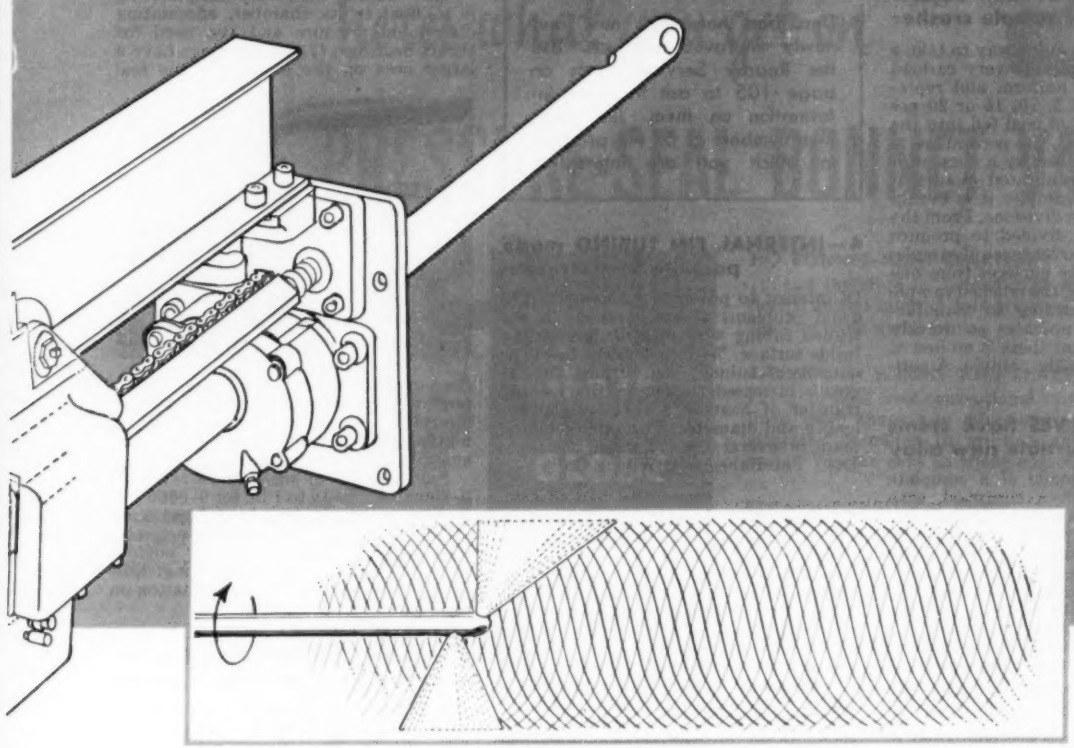
WHY VULCAN



Shown is the Vulcan T-3-E Long Retractable Soot Blower with electric drive. The T-3 Long Retractable is air-driven.

VULCAN Automatic

USES 2 MOTORS



This cleaning pattern—an infinite number of double-helix paths—makes the second motor of a Vulcan Long Retractable Soot Blower a most profitable investment. Two motors cost more—but they are worth more.

To get such thorough cleaning—with the blowing steam or air always cleaning a new path—you must have two motors. One motor moves the lance in and out—the other rotates it. And with the two motors, traversing and rotating speeds are independently adjustable for your exact needs.

This double-helix pattern cuts tube replacement costs. There is no danger of the blowing medium constantly striking—and wearing away—the same part of each tube. Packing life is increased.

These are reasons why Vulcan "Long Retracts" are found on so many new high-duty boilers. Users know Vulcans pay for themselves quickly and often. The story is told in Bulletin 1002. Write for it.

COPES-VULCAN DIVISION
CONTINENTAL FOUNDRY & MACHINE COMPANY
ERIE 4, PENNSYLVANIA

For more data circle 530 on Post Card

EQUIPMENT NEWS

Described here are new and newly improved products. Use the Reader Service Cards on page 105 to ask for more information on them. Just circle item numbers of all the products in which you are interested.

1—SAMPLING HOPPER, adjustable, for sample crusher

This hopper offers a quick way to take a sample of the sample of every carload of coal. It gives a uniform and representative sample of 5, 10, 15 or 20 per cent of the amount of coal fed into the mill, it is pointed out, the percentage of sample being controlled by a simple-to-operate lever and calibrated quadrant. As coal enters the sampler it is evenly divided among three divisions. From the third division it is divided to produce any of the desired percentages of sample. The sample quantity emerges from one spout; the balance of the crushed sample from another. According to manufacturer, the hopper operates so quickly and so efficiently that there is no loss of moisture content in the sample. American Pulverizer Co.

2—BRONZE VALVES have stems made of a durable new alloy

Announcement is made of a complete line of bronze valves equipped with stems of Coradur, an aluminum-silicon-bronze alloy developed to overcome the problems of corrosion and dezincification. According to manufacturer, this new stem material combines a favorable machining index with excellent durability. While lighter than naval brass, it is said to offer high tensile strength (over 95,000 psi), about twice the hardness, and a low coefficient of friction for longer wearing stem threads and bonnet threads.

The Coradur stems are composed of 91 per cent copper, 7 per cent aluminum and 2 per cent silicon. They are being machined for company's bronze globe, angle and gate valves. R-P & C Valve Div., American Chain & Cable Co.

3—UNIT-SUPPORTED BUS, three phase, of isolated phase design

Declared capable of withstanding high short circuit currents of modern power systems and having a margin for future system growth, this unit supported bus is generally used for direct connection of generators and main power transformers in a unit generation system. The equipment weighs less than present typical three-phase sections and, having single insulator supports, affords easier installation and maintenance than previous bus designs, according to company engineers. They point out that the single supports reduce the possibility of insulation failure.

It is explained that the use of such supports was possible because the metal sheath around the bus keeps the lines of force due to magnetic flux from acting between the conductors — an area of "zero force" existing at the center of the enclosure, and conductors located there require a minimum of support.

Other features for simplifying maintenance include smaller covers with less gasketing area, simplified hardware on covers, and welded end bells for greater strength. The new bus is available in lengths of three-phase sections up to 16 ft and ratings up to 10,000 amp, 14.4 to 34.5 kv. General Electric Co.

4—INTERNAL FIN TUBING made possible by extrusion

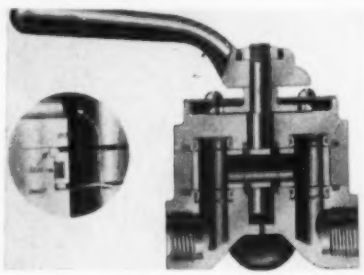
Of interest to power engineers with unusual problems of heat transfer is extruded tubing with integral fins on the inside surface. With fins on the inside or outside of tubing, the surface area is greatly increased, thus permitting greater transfer of heat in a tube of a given length and diameter. The tubing can be made in several steels. Tubular Products Div., The Babcock & Wilcox Co.

5—EXHAUST SILENCERS, high velocity, for steam and air

For noise control in critical and non-critical areas, the Series "ADS" Acoustic Discharge Silencers are designed to eliminate high and lower frequency noises caused by high velocity discharges from steam and air devices. They are used on steam vents and safety valves, evacuating ejectors. Three models will be available: ADSO for optimum silencing in critical areas; ADSS for light industrial areas, and ADSC for commercial silencing in non-critical areas, all in standard 8- to 30-in. pipe size. Further information is found in Bulletin 265. Burgess-Manning Co.

6—SELECTOR VALVE handles pressures up to 6000 psi

In this "balanced" selector valve, the body, ported as desired, encases a disk with internal flow passages. As the disk is revolved to produce flow through the ports, sealing rings act to eliminate cross leakage. Manufacturer points out that a 6-in. handle is adequate for turning the disk under 6000 psi pressure. This low turning torque is attributed to two design features: (1) Fluid reaches "both" sides of the rotary disk, causing it to float in its chamber, eliminating directional pressure and the need for thrust bearings; (2) sealing rings have a larger area on the bottom of the seal than on the surface toward the disk for positive seal contact, regardless of flow direction or pressure. There is an equal number of seals on each side of the disk, again balancing pressures.



Valves come in sizes $\frac{3}{4}$ to 1 in. for 0–2000 psi, and $\frac{1}{4}$ to 1 in. for 0–6000 psi, for most services; for air and gas service, 0–1000 and 0–3000 psi, respectively. Porting types include side or bottom pipe tap, and sub-plate mounting. Bulletin 454 gives additional information on this valve. Republic Mfg. Co.

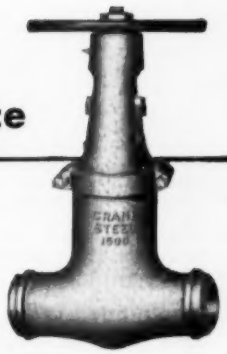
7—ONE-PIECE SEAL CAGE is designed for longer service

The Chempro Teflon Seal Cage is a one-piece flexible unit for use with stuffing boxes on pumps, mixers, reactors and other processing equipment. It is claimed to be longer lasting than two-piece metal lantern rings, and to allow easy snapping over the shaft without dismantling pump or pulling the shaft. Manufacturer says this seal cage will not score the shaft during operation even at high speeds, and is designed not to bend or collapse under extreme gland pressure. Cages are available in standard or special sizes for pumps, mixers, agitators. Chemical & Power Products, Inc.

8—NEW SILVER FINISH aids pulling power of cable

For easier installation of non-metallic-sheathed cable, this company offers a smoother, cleaner surface on its new Silver Dutrax, Type NM, which it claims can be pulled through joists with

for high-pressure high-temperature service



here's what you get in

CRANE PRESSURE-SEAL BONNET VALVES

IN 600, 900, AND 1500-POUND PRESSURE CLASSES

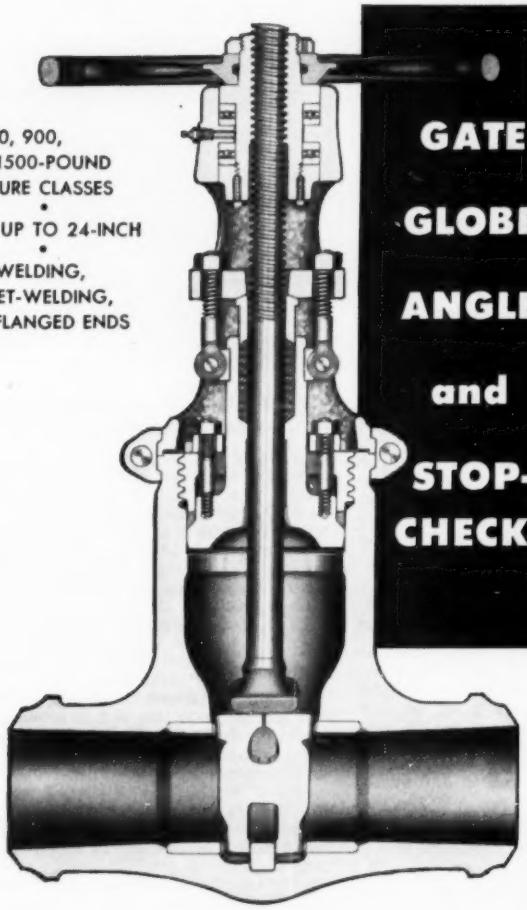
•

SIZES UP TO 24-INCH

•

BUTT-WELDING, SOCKET-WELDING, AND FLANGED ENDS

GATE
GLOBE
ANGLE
and
STOP-CHECKS



NO BONNET-JOINT LEAKAGE
. . . and therefore no bonnet-joint maintenance. Crane design utilizes internal fluid pressure to form a pressure-tight metal-to-metal joint.

SAVINGS IN WEIGHT AND SPACE
. . . up to 60% over conventional valves. Crane streamlined valve shape also minimizes service strains and stresses. Handling in erection and maintenance is easier. You can save on piping suspension, too.

STRAIGHT-THROUGH FLOW
. . . in gate valves, resistance to flow is minimized because inner diameter of body seat rings and inside surface of disc guide are in line. Globes and stop-checks also have excellent flow characteristics.

SMOOTH, EASY OPERATION
. . . for instance, in larger size gate valves, a flexible wedge disc prevents sticking . . . is not "pinched" in the valve body by contraction as the result of cooling . . . requires minimum torque to open.

CRANE QUALITY THROUGHOUT
. . . depending on service requirements, bonnet and body are Crane Carbon-Molybdenum or Chrome-Molybdenum Alloy Steels. All seating surfaces are long-lasting Stellite. Body seat rings are accurately fitted and welded, and cannot loosen in service.

Get better acquainted with this modern Crane line—ask your Crane Representative for a copy of folder AD1936, or write direct.

In the cross-section you can see how the bonnet-joint is *inside* the valve. Internal fluid pressure, acting upon the entire underside of the bonnet, forces the bonnet against the seal ring between body and bonnet, forming a pressure-tight metal-to-metal joint.

THE BETTER QUALITY . . . BIGGER VALUE LINE . . . IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

For more data circle 531 on Post Card

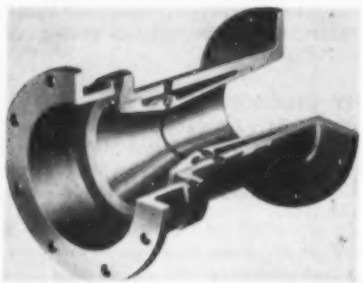
less effort than ordinary cable. Storage tests on Type NM at 170 F, followed by cooling down to 70 F, are said to have resulted in tack-free cable throughout, layers free from each other, and the coil easy to feed out. The cable is said to strip easily, its smooth outer finish allows easy fishing, and its small diameter makes it well suited for wiring in existing buildings. Available in twin-conductors, sizes 14 to 8 awg; in three-conductor round, sizes 14 to 6 awg. Standard lengths are 250-ft coils for sizes 14, 12 and 10, and 125-ft coils for sizes 8 and 6 awg. Anaconda Wire & Cable Co.

9—MEASURING TAPE, non-metallic for high tension circuits

The Hi-Line, a lightweight, non-metallic woven tape, is reported to be well suited for power, utility and general work around high tension circuits. It may be used for highway and construction work where steel tape accuracy is not required. Hi-Line is claimed to have great dimensional stability even after repeated soakings. Markings are protected by coatings of plastic that is resistant to abrasion, moisture, mildew and temperature changes. The first end of the tape is reinforced with green plastic, imprinted "Non-Metallic." "Instantaneous" readings are faster — with the preceding foot number repeated each inch (or tenth of a foot) in red. The tape is furnished in a leather case. The Lufkin Rule Co.

10—FLOW TUBE for metering of liquids and gases

The Dall Flow Tube is designed for use with fluids carrying no settleable solids. It consists of a short, flanged, cylindrical body designed with an abrupt decrease in diameter, followed by a conical restriction and diverging outlet. The reduced area at the cone entrance, together with the design of the annular



throat, induces the high differential pressure obtained, it is noted — the diverging outlet cone providing high recovery of differential pressure.

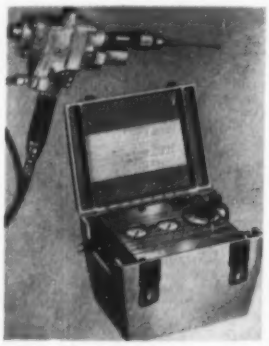
Among features announced for the tube are low permanent head loss, short length and low weight for easy installation; Meehanite iron body and corrosion resistant bronze liner; low maintenance due to unobstructed flow path. Capacity tables and head loss data are offered. Builders-Providence, Inc.

11—SMALL AIR VALVES for instrumentation installation

These instrument air valves are equipped with company's Swagelok ends to provide leakproof and torque-free seals. The arrow on the valve body shows direction of flow. The valves are being made in brass, aluminum, steel and stainless steel. Crawford Fitting Co.

12—TUBE ROLLING CONTROL is powerful electro-pneumatic unit

The John Crane Electro-Pneumatic Tube Rolling Control is announced as combining advantages of air operation



with precision electric control. It has an air motor which provides increased power and flexibility to give faster tube rolling and permit use of only one motor for a wide range of tube sizes, both ferrous and non-ferrous. It is designed for rolling ferrous tubes up to 2¼ in. ID, and is thus adaptable for use on condensers, heat exchangers, boilers, evaporators, coolers and other types of equipment.

Pneumatic-electric control affords controlled amount of tube expansion into the sheet, company points out, so that tightness and holding strength are held to the amount required, and "leakers" and over-rolling are eliminated. Also, it is claimed that "cold work" crystallization is minimized and distortion or fracture of ligaments in the tube sheet is prevented. Skilled operators are not required to operate the control.

The new unit is designed to handle three sizes of air motors, one for non-ferrous tubing to 1¼ in. ID; one for non-ferrous tubing to 1½ in. and ferrous to 1¼ in. ID; and one for ferrous tubing to 2¼ in. ID. Bulletin P-318 describes the control. Crane Packing Co.

13—INSTRUMENT "answers" phone; reads gas, water level

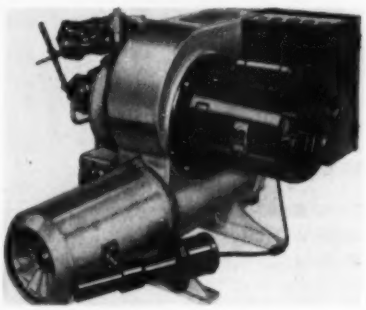
The Metaphone, an instrument which can be installed at any point in an unattended gas holder or water reservoir, answers the telephone and gives a storage condition reading by means of a time signal. The measuring system closes an electrical circuit for a length of time proportional to the height of the water in the tank, or to the pressure of the gas in the holder.

The electrical circuit includes a buzzer mounted before a telephone transmitter. When someone dials the unattended phone and opens the transmission circuit, he can hear the signal; and by timing its duration with a stopwatch, he knows the condition of the storage tank. For example, if a 60-ft high water tank is full to a height of 40 ft, the buzzer sounds for 40 sec, then is quiet for 20 sec, then repeats the 40-sec signal. Cost of installing and operating the device is said to be less than regular telemetering systems. The Bristol Co.

14—GENERATOR UNIT for temporary or standby service

Utilizing the same type engine used on many of company's diesel locomotives, this compact new portable generator can be equipped with a 9- by 10½-in. four-cycle turbocharged diesel in sizes from 390 to 1300 kw. In addition to the engine, all auxiliary equipment — including generator, exciter and switch gear — is mounted on skids, so the unit is ready to operate when the power cables are connected. The entire power plant can be enclosed.

A vertical-type radiator provides jacket water cooling with an ambient air temperature of 100 F. The fan is driven by V-belts with the driving shaft on an extension of the crankshaft. Thermostatic control of radiator shutters is furnished to maintain required jacket water temperature. The generator on the six-cylinder engine is a high-speed type with one outboard bearing mounted in the end shield. On the 12- and 16-cylinder units, the generator is of the engine type with a pedestal outboard bearing; the exciter is on top of the generator stator and driven by V-belts. American Locomotive Co.



15—HEAVY OIL BURNER offers greater heating flexibility

Because of its 35 per cent increase in capacity, the new Model 4 Hev-E-Oil Burner is adaptable to a wider range of heating conditions. It is intended for use where a burner is used to heat a building containing over 1500 sq ft of radiation, or where more than 6000 gal of oil or where more than 45 tons of coal per year is burned.

With its larger capacity, the new "4" also incorporates features designed for increased fuel savings, less maintenance and simplified installation. Like other models in this manufacturer's Hev-E-Oil Burner line, this is a low pressure, air-atomizing type. It is said to be the only modern all-electric ignition oil burner designed to burn low-cost No. 4 or 5 oil without preheating. According to manufacturer, greater efficiency is gained without increase in power consumption; it is sensitive to heat demands and designed to provide steady proportioned heat for power loads and for heating. Cleaver-Brooks Co.

16—METAL COATING, fish oil based, arrests rust

A fish-oil base, rust-arresting metal coating for direct application on the rusted surface, Rust-Sele requires only that the surface be wire-brushed to remove loose rust, paint, scale and dust. Manufacturer says its penetrability makes it a maintenance time saver, and the flexible, film-forming quality allows the protective coating to stretch with the expan-

Consider the unique K-Weld technique...

when critical piping is the order!

With today's operating conditions already approaching the limits of available power piping materials, the necessity for expert fabricating techniques cannot be overstressed. And it is here that the K-Weld process, Kellogg's unique welding method, has already played an important part.

For example, K-Weld was used throughout—both in the shop and in the field—for the welding of austenitic stainless steam piping for service at 1100°F and 2350 psig on two 145,000 Kw units in Kearny station of Public Service Electric and Gas Co. of New Jersey.

Main advantage of this new welding process lies in the fact that it assures *complete penetration without backing rings*. Their elimination precludes the possibility of crack propagation at the weld root which would produce ultimate failure as a result of severe operating conditions.

An additional advantage is the elimination of the possibility of the backing ring breaking off and damaging equipment. Furthermore the lack of a ring materially reduces turbulence in pipes.

The K-Weld process—developed in Kellogg's Welding and Welding Practices Group—entails the use of inert-gas arc welding of the first pass with inert-gas under *controlled pressure* on the inside of the piping. It permits an average welder qualified for inert-gas arc welding to obtain excellent results either in the field or in the shop. The K-Weld technique may be used on all power piping materials.

Fundamental development work leading to advances in the art of fabrication is an important part of Kellogg's basic stock in trade. Many power station designers and utility companies also say it's one basic reason why they time and again specify Kellogg when critical power piping is the order.

New Power Piping Booklet Published . . . Send for descriptive literature about Kellogg's extensive facilities for assuring the highest quality workmanship. A section of the booklet is devoted to detailed coverage of the K-Weld process. **Write: Power Piping Dept.**

These leading companies are among the many major producers of power who use M. W. KELLOGG POWER PIPING...

- Consumers Power Co.
- Detroit Edison Co.
- Dow Chemical Co.
- Elektricitetsselskabet Isefjordvaerket (Denmark)
- Ford Motor Co. of Canada Ltd. (Canada)
- General Electric Co.

OTHER FABRICATED PRODUCTS **include: Pressure Vessels . . . Vacuum Vessels . . . Fractionating Columns . . . Drums and Shells . . . Heat Exchangers . . . Process Piping . . . Bends and Headers . . . Forged and Welded Fittings**

For further information, details of methods, etc. contact

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sion-contraction of the treated surface. Rust-Sele is designed to withstand temperatures to 450 F.

Two types are offered: "long-oil" coatings for exterior, and "short-oil" for interior use or in sheltered exterior locations. Long-oil has higher fish-oil concentration for resistance to rain, extreme temperatures and corroding action of fumes, while the short-oil has fast-drying qualities. Both are available in 24 colors, including white, aluminum and black, and are packed in 1- and 5-gal cans and up to 55-gal drums. A test sample offered. Rust-Sele Co.

17—ADAPTER COVER permits receptacle installation

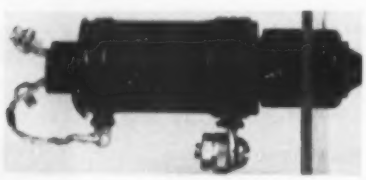
A raised adapter cover, Catalog 1710-RS, is designed to accept the Ever-Lok receptacle device without need for installation of separate boxes. It snaps on company's Surfaceduct raceway like the standard capping, permitting installation of the receptacle within the body of

the duct. Although designed for the 20-amp Ever-Lok receptacle, it is also said to accommodate other devices.

The cover expands applications of a continuous raceway system with multiple outlets installed within the duct, it is pointed out, and this installation does not require stopping service or cutting channel. The cover is made of 19-gage steel, size 4½ by 2⅛ in.; and is supplied with two Surfaceduct mounting bridges and mounting screws. National Electric Products Co.

18—INDICATING LAMP for switchboard steel panels

An all-molded indicating lamp for switchboard steel panels features compound color caps treated to increase the glow of light; a series resistor to provide long life expectancy, and a standard 24E telephone lamp with slide base to allow easy changing of bulbs. Available in six



colors and for panels up to ¼-in. thick, the lamp is approximately ½ in. shorter than company's previous models. General Electric Co.

19—SOLENOID VALVES designed for 0 to 250 psi oil service

Shear-Seal Solenoid Valves are designed for 0 to 250 psi oil service. They are declared not critical to pipe scale or other foreign material in the liquid, because the lapped sealing members are in constant intimate contact. The wiping action of the Shear-Seals pushes dirt aside and lets it flush out through the return port. Manufacturer says no eroding or scoring occurs, because flow is through the sealing members and never across the sealing surfaces. Pipe sizes of ¼-, ⅜- and ½-in. are available in four-way, three-way, and shut-off models. Barksdale Valves.

20—FLOW CELL ASSEMBLY is small, easily serviced

Easy removal of the conductivity cell for cleaning or inspection is a feature announced for this conductivity flow cell assembly. It can be used together with a conductivity meter or recorder to determine electrical conductivity of condensed steam and feedwater. The assembly is less than 10 in. long, and the cell is said to be so small there is practically no holdup to level out differences in conductivity.

The assembly can be furnished with cells having different constants. A bimetallic dial reading thermometer is supplied as a standard component. Principal "wet" components are made of stainless steel. Hagan Corp.

21—VACUUM BOOSTER PUMP, rotary positive displacement type

For use as a high vacuum stage in the low pressure range where single stage vacuum pumps have poor volumetric efficiency, the Model MB is a mechanical booster vacuum pump with mechanical shaft seals. As a vacuum booster pump it is specially designed to exhaust into the inlet of company's single stage pump acting as a second stage or backing pump.

According to manufacturer, the combined unit has a wider high vacuum range with lower power consumption than has been realized up to now. The Model MB is described as unique in that no sealing fluid is required, and being free of volatile materials the booster acts as a positive displacement compressor to retard backstreaming of oil vapors into vacuum system. The result is said to be cleaner pumping action. Kinney Mfg. Div., New York Air Brake Co.

22—VOLTMETER, expanded scale, records 100 to 500-v range

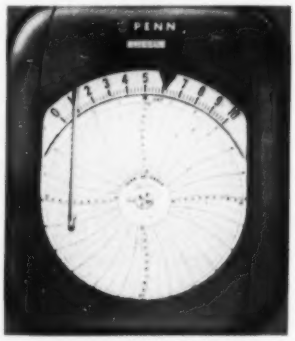
An advanced a-c voltmeter featuring scale expansion and recording over the 100- to 500-v range covers the voltage range in 39 easy-to-read 10-v steps, full scale. True RMS readings are obtained with accuracies better than ± 0.25 per cent of input voltage, manufacturer claims; frequency response is uniform between 50 and 2000 cps.

This voltmeter offers built-in recorder connections for continuous recording of line voltage fluctuations with a 1-ma d-c recorder to simplify voltage regulation or stabilization in any a-c system. More details are in Bulletin 101. Arga Div., Beckman Instruments, Inc.

23—FLOW METER for modern panel instrumentation

According to manufacturer, this well-known tilting U-tube mechanical flow meter has been given a "face lifting" to adapt it to present-day panel instrumentation. But the basic operating principle of a U-tube balance has not been changed dynamically or dimensionally, company says — it's still the same powerful mechanical meter. It records flow on evenly graduated charts and may be equipped with pneumatic transmitter which provides air output directly proportional to flow.

Utilization of torsion tubes has eliminated the necessity of springs, bellows, stuffing boxes and pressure-tight bearings, it is explained, the new design incorporating a rugged simplicity which requires little maintenance. Calibration



can be checked with disturbing pipe connections and the differential range may be altered by changing the cam weight. The case is pressed steel; manometer, welded steel. Catalog 1027 gives details. Penn Industrial Instrument Corp.

24—PIPELINE REGULATOR for systems using low pressure

A new 8900 series of regulators to supersede this company's 8600 series has been designed for use with gases supplied by pipeline systems using comparatively low pressures. These oxygen cutting and welding regulators are said to afford greater flow capacities, improved regulation and lower static increment, and, despite fluctuation in the line pressure, to maintain a steady gas pressure. Of inverse-type design, they require no nozzle. Other advantages claimed are long service life, ease in operation and repair. More information on this regulator is given in Catalog ADC 705. Air Reduction Sales Co.

25—INSTRUMENT VALVE, high pressure, is small and light

Specially engineered for such services as instrument panels and lines, gage, bypass and corrosive lines, and orifice meters, the new 6000 psi Hancock Stainless Steel Instrument Valve is small, and weighs only 2¼ lb. Its compactness per-

mits close alignment of piping with near structures. The packing gland can be pulled tight in close quarters and disassembly is said to present no problem. The valve comes in ¼, ⅜ and ½ in. sizes. Manning, Maxwell & Moore, Inc.

New diesels get same "lube diet" that kept old units healthy...

For many years, the Las Animas Municipal Power and Light Company kept its original diesel equipment operating at remarkably low cost. Using Standard diesel oils, down time and maintenance were negligible in spite of greatly increased loads that forced the units far beyond their rated capacities.

In 1951, when two new 1750 hp. Nordbergs were installed in the Las Animas, Colorado, power plant, it was natural for plant officials to select STANDARD HD Diesel Oil on the basis of this outstanding past performance.

Used exclusively in the new units, STANDARD HD has set a new high for healthy performance. In over two years of continuous hard service, STANDARD HD has supplied clean, protective lubrication. After 6000 hours of operation wear was so slight that it could not be measured; engines are kept clean constantly in all working parts.

STANDARD HD
TRADE MARK
OIL

• Diesel plant operators throughout the Midwest have discovered they can count on low cost diesel operation when they use STANDARD HD Oil. STANDARD HD provides an economical solution for costly maintenance problems—ring sticking and breaking, carbon deposits, cylinder wear—because STANDARD HD Oil lubricates, cleans *and* protects.

A Standard Oil lubrication specialist stationed near your plant throughout the Midwest can help you secure successful results in the operation and maintenance of your diesels. For his services, call your local Standard Oil Company office. Or write: Standard Oil Company (Indiana), 910 S. Michigan Avenue, Chicago 80, Illinois.

Ralph Barbee, plant superintendent of the Las Animas Municipal Power and Light Company, checks the operating log with E. C. Jeffries, Standard Oil lubrication specialist.

STANDARD OIL COMPANY
(Indiana)

STANDARD

For more data circle 533 on Post Card

CONSTRUCTION NEWS

Scottsboro, Ala. — Burlington Mills Corp., Greensboro, N. C., textile products, plans steam power house at proposed new mill at Scottsboro, for manufacture of nylon hosiery. Tract of about 23 acres of land has been acquired. Mill will comprise a main one-story structure and several auxiliary buildings. Cost estimated about $1,200,000. Work scheduled to begin soon.

Redding, Calif. — Pacific Gas & Electric Co., 445 Sutter St., San Francisco, Calif., has preliminary plans under way for large hydroelectric power projects on McCloud and Pit Rivers, Siskiyou and Shasta Counties, near Redding, comprising a series of 8 power dams, two hydroelectric generating stations, 5 tunnels totaling 17 mi. in length, artificial lakes and other facilities. One station will be equipped for a rated capacity of 154,000 kw., and other 32,000 kw. Entire project estimated to cost close to $90,000,000. Application for permission has been made to Federal Power Commission, Washington, D. C.

Sunnyvale, Calif. — Pacific Can Co., 220 Division St., San Francisco, Calif., tin cans and other metal containers, plans power house at new branch plant at Sunnyvale, where large tract of land has been selected. It will be one-story, about 200,000 sq. ft. of factory space. Entire project will represent a reported investment of about $2,000,000.

Denver, Colo. — American Can Co., Central Div., 104 So. Michigan Ave., Chicago, Ill., tin and other metal containers, plans power house at new branch plant at Denver, where site has been selected. It will comprise several production units, totaling about 60,000 sq. ft. floor space. Entire project is reported to cost over $600,000. Proposed to begin work soon.

Gainesville, Fla. — Department of Public Utilities has plans for addition to municipal power plant. New equipment will be installed for increased capacity. No estimate of cost announced. Ebaugh & Goethe, 205 N. W. 10th. Ave., are engineers.

Griffen, Ga. — Stowe-Woodward, Inc., Newton Upper Falls, Mass., rubber-covered rollers, rubber-lined tanks, etc., plans boiler house at new branch plant at Griffen, where tract of 16 acres of land has been secured. It will consist of a main building, about 25,000 sq. ft. floor space, and several smaller structures.

Morris, Ill. — The Maytag Company of Newton, Iowa, has abandoned the three-million-dollar branch plant at one time considered for this area and announced on this page in the February, 1954 issue.

Naperville, Ill. — Foote Bros. Gear & Machine Co., 4545 So. Western Blvd., Chicago, Ill., industrial gears, gear motors, etc., is considering a power house at proposed new plant at Naperville. Tract of 120 acres of land has been secured. Initial plant structures will total about 100,000 sq. ft. floor space. Entire project reported to cost over $1,000,000. Graham, Anderson, Probst & White, 80 East Jackson Blvd., Chicago, are architects.

Indianapolis, Ind. — Indianapolis Power & Light Co., 17 No. Meridian Ave., has authorized an expansion and development program during next 48 mos. to cost about $42,000,000, including extensions in generating facilities, power substations, transmission lines and other operating facilities. Plans are under way for addition to White River generating station, with installation of new 105,000-kw. turbine-generator unit, high-pressure boiler and auxiliary equipment, estimated to cost about $14,600,000 of total sum noted.

Coffeyville, Kan. — Municipal Water & Light Dept., plans new municipal power plant, with installation of turbine-generator, high-pressure boiler and auxiliary equipment. Cost estimated about $3,300,000. A bond issue in that amount is being arranged. Lutz & May, Finance Bldg., Kansas City, Mo., are consulting engineers.

Winchester, Ky. — Eastern Kentucky Electric Cooperative, Inc., Winchester, has plans maturing for addition to Ford steam-electric generating station on Kentucky River, with installation of new 60,000-kw. turbine-generator unit, high-pressure boiler and auxiliary equipment, and will begin work soon. No estimate of cost announced — will represent a large investment.

Baton Rouge, La. — Gulf States Utilities Co., Louisiana Division, 340 Florida St., plans extensions and improvements in power plants and system in 1954 to cost about $17,000,000, including increased generating facilities, power substations, transmission lines and other work. Main offices are at Beaumont, Tex.

Winslow, Me. — Hollingsworth & Whitney Co., 60 Batterymarch St., Boston, Mass., manila, food packaging and other papers, plans expansion and improvements in power plant at mill at Winslow, near Waterville, with installation of new 7500-kw. turbine-generator, high-pressure boiler and auxiliary equipment. This will form part of a general extension program at mill to be carried out over a period of months, with cost estimated close to $7,000,000.

Watertown, Mass. — Watertown Mfg. Co., Echo Lake Rd., plastic products, molding powders, etc., has approved plans for new boiler house at plant, and will proceed with work at early date. New boiler and auxiliary equipment will be installed. No estimate of cost announced.

Detroit, Mich. — Detroit Edison Co., 2000 Second Ave., has arranged an expansion and improvement program in plants and system in 1954 to cost about $73,000,000, including extensions in generating stations, power substations, transmission lines and other operating facilities. Company has purchased a power site at Monroe, Mich., fronting on Lake Erie, and is said to have negotiations under way for another power site on Lake Huron.

Gladstone, Mich. — Municipal Power Dept. has plans under way for new municipal power plant, estimated to cost about $400,000, with generating unit, boilers and auxiliary equipment. Proposed to arrange bond issue in amount noted. Pfeifer & Shultz, Wesley Temple Bldg., Minneapolis, Minn., are consulting engineers.

Muskegon, Mich. — Continental Motors Corp., gasoline, natural gas and other internal combustion engines, has approved plans for addition to power plant at local downtown works, with installation of a new turbine-generator unit and auxiliary equipment. Work will proceed at once. Cost reported about $2,000,000.

Three Rivers, Mich. — Beechnut Packing Co., Canajoharie, N. Y., prepared food products, peanut butter, coffee, etc., plans power house at new branch plant at Three Rivers, where site is being secured. It will comprise several buildings, equipped for processing and production. Cost reported over $1,600,000. Proposed to begin work soon.

Pine Bend, Minn. — Great Northern Oil Co., William J. Carthaus, president, First National Bank Bldg., St. Paul, Minn., recently organized, plans power plant at new oil refinery at Pine Bend, vicinity of South St. Paul, where tract of 900 acres of land has been selected. It will consist of a group of one and multi-story structures for different divisions of production, equipped for large output. Entire project is reported to cost about $20,000,000. Proposed to begin work soon.

Flemington, N. J. — Visking Corp., Plastic Products Division, 6733 West 65th, St., Chicago, Ill., plastic tubing, sheeting, etc., is said to be planning a power house at proposed new branch plant in Raritan Township, near Flemington, where tract of about 20 acres of land, fronting on Raritan River, has been purchased. Plant will consist of a main one-story structure and several smaller units, and is reported to cost about $1,500,000.

Vineland, N. J. — Municipal Electric Dept. has approved plans for expansion in municipal steam-electric power station, with installation of equipment for increased capacity. No estimate of cost announced. Work will be placed under way soon.

Johnstown, Pa. — Pennsylvania Electric Co., Johnstown, has arranged financing in amount of $12,000,000 through sale of bonds, proceeds to be used for extensions and improvements in power plants and system, including generating facilities, power substations, transmission lines and other work.

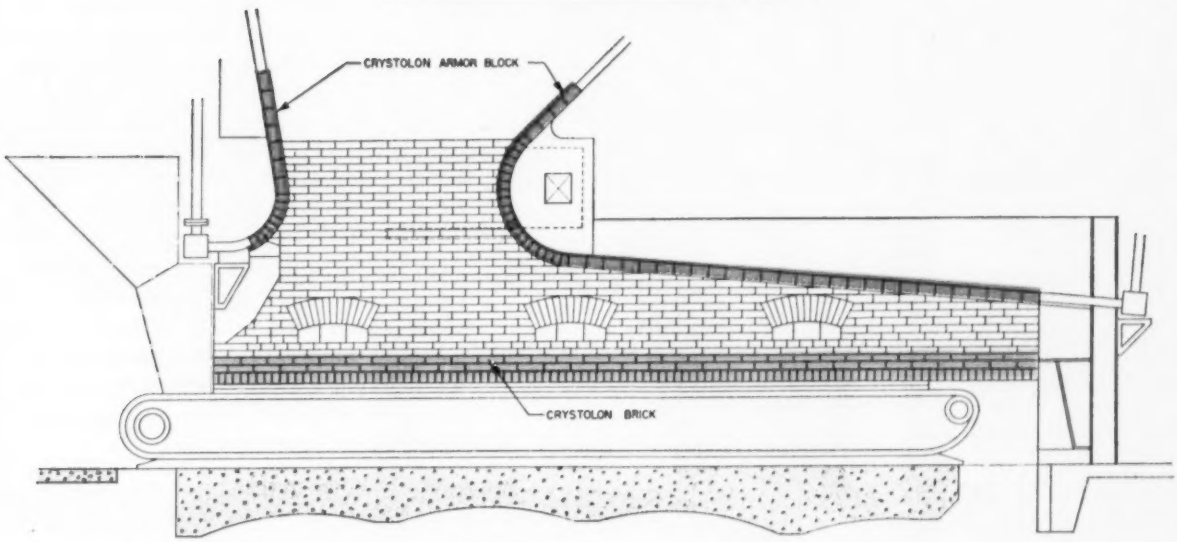
Dallas, Tex. — Dallas Power & Light Co., 1506 Commerce St., has arranged for sale of an issue of preferred stock, totaling about $7,000,000, proceeds to be used for expansion and improvements in generating facilities, power substations, transmission and distributing lines, and other work.

Timpson, Tex. — United Chemical Co., care of Grover Hartt, Fidelity Bldg., Dallas, Tex., oil operator, president, recently organized, plans power house at new petrochemical plant at Timpson, for manufacture of anhydrous ammonia and urea fertilizers. It will comprise several large production units, and is reported to cost about $15,000,000. Site has been selected. Proposed to begin work soon.

Portsmouth, Va. — Virginia Electric & Power Co., Richmond, Va., has authorized extensions and improvements in generating station at Portsmouth, to cost about $1,000,000. Program will include additional oil fuel facilities and other station betterments. Work will proceed at early date.

Milwaukee, Wis. — Wisconsin Electric Power Co., 231 West Michigan St., Milwaukee, Wis., will begin superstructure soon for addition to steam-electric generating station near Oak Creek, Milwaukee County, previously referred to in these columns. It will be 140 x 150 ft., over 100 ft. high, and will provide for installation of a third turbine-generator and auxiliary equipment. Entire project is estimated to cost about $23,600,000.

CRYSTOLON* Refractories give vital protection — *two ways*



Norton brick and armor block provide two money-saving Rx's — reduce abrasion and safeguard water tubes

This diagram of a chain grate, stoker fired boiler shows how abrasion of the setting by moving fuel has been cut to a minimum. Three to five courses of CRYSTOLON brick at and above grate level are all that are needed. The extreme hardness of this Norton *engineered and prescribed* refractory gives the same excellent results where severe flame erosion is encountered.

Above this brick, the diagram also shows how the water tube front and rear arches are protected against hot, swirling gases by CRYSTOLON armor blocks. Their high heat release supports combustion and preheats any infiltrated air from the ash pit entering the main boiler section.

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

New booklet gives you the whole story

The above is just one of the applications described in the new Norton 24-page illustrated booklet on *Refractories For Heat and Power*. To learn how these highly efficient, quality-controlled refractories supply a performance-improving Rx for every boiler application, write for your copy today. NORTON COMPANY, 614 New Bond Street, Worcester 6, Mass. *Canadian Representative:* A. P. Green Fire Brick Co., Ltd., Toronto 5, Ontario.

NORTON REFRACTORIES

Engineered . . . Rx . . . Prescribed

Making better products . . . to make other products better

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ACCO products

New 10,000 psi Rating for R-P&C Bar Stock Valve

New structural improvements in R-P&C's popular **Fig. 1040-A** carbon steel bar stock valve have resulted in substantially higher ratings for these rugged close control valves. New ratings range from 10,000 psi at 150°F to 475 psi at 1000°F. Sizes from ⅛" to 1". Each valve passes a hydrostatic test at 15,000 psi before leaving the factory.

R-P&C bar stock valves can supply an inexpensive, dependable answer to many of your valve application problems—particularly if these involve throttling or other close control service, high temperatures or high pressures. They are uniquely adapted for meter, gauge or instrument service or in crowded applications such as panel boards.

Fifteen different Fig. numbers in R-P&C's complete bar stock line provide close flow control for a wide variety of fluids. Pressure and temperature ratings, which vary for different materials and constructions, cover an extensive range. Among special applications covered are—

for Corrosion Resistance:

R-P&C Bar Stock valves are manufactured in 12-14% chromium stainless steel, and 18-8 molybdenum stainless steel for use with corrosive fluids—also particularly applicable for sub-zero service.

for Severe Throttling Service:

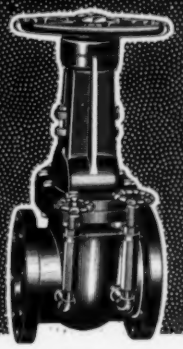
Fig. 1060-S Bar Stock valves have special discs of STELLITE—providing resistance to abrasion by cutting particles in extremely severe throttling service such as continuous blow-down with steam, water or other fluids.

for Close Quarters, Unusual Piping Hook-ups:

The adaptability of R-P&C Bar Stock valves solves installation problems. These versatile valves are supplied in globe and angle styles with female ends, male and female ends, or male union ends. Also provided with welding or silver-soldering ends for welded piping systems. Special lock bonnets provide additional protection in applications involving constant vibration.

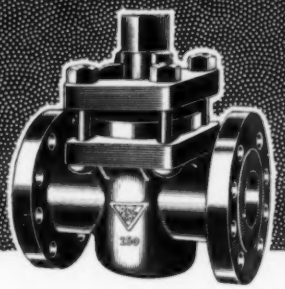
Write TODAY FOR CATALOG

Pressure sealed bonnet joint cast steel valves are furnished in gate valve and globe valve styles in 900 lb., 1500 lb., and 2500 lb. pressure classes.



Lubrotite Gate Valves, exclusive with R-P&C, provide a patented lubricant seal which gives positive shut-off, retards corrosion, reduces maintenance. Furnished in iron, iron with bronze trim, cast steel with stainless trim, in sizes from 2" to 24".

Cast steel fittings, ells, tees, laterals, crosses, reducers—screwed or flanged ends. Furnished in a wide variety of sizes up to 24", in pressure classes from 150 to 2500 lbs.



Asbestos-packed cocks, an R-P&C exclusive, are furnished in iron in sizes from ¼" to 6" with screwed or flanged ends.

Fig. 212 screwed end bronze check valve typifies R-P&C's complete check valve line—furnished in iron, bronze or cast steel in sizes ranging from ¼" to 24".

Forged steel gate valves, like Fig. 6056 above, are offered in sizes from ¼" to 2" with flanged, screwed or welding ends. Pressure ratings range from 2000 psi at 100°F to 380 psi at 1000°F.

Which of these FREE TECHNICAL AIDS do you want?

R-P&C manufactures a *complete* line of valves—the units above only begin to indicate the comprehensiveness of the R-P&C line. In addition R-P&C supplies complete technical assistance—provides every possible aid to assist the buyer in valve selection, installation and operation. A few of these technical aids are shown at right.

Any of the above technical aids furnished promptly on request. Write R-P&C Valve Division, American Chain & Cable, Reading, Pennsylvania.

VALVE SELECTOR SLIDE RULE

Handy selector slide rule gives all dimensions for iron body valves, steel valves in 150, 300, 400, 600, 900 and 1500 lb. classes.

HOW TO SELECT VALVES

17" by 11" wall chart lists principles to use in selecting valves for various applications . . . considers effects of fluids, temperatures, pressures, sizes and service requirements. Glossary of valve terms included.

HOW TO PROTECT YOUR VALVES

17" by 11" wall chart lists 22 installation and operation pointers to protect valves, get maximum life. Includes glossary of valve terms.

HOW TO KNOW VALVES

17" by 11" wall chart graphically shows appearance, construction, operation, recommended applications for gate, globe and check valves, cocks. Also National Safety Council operating recommendations.

ACCO

TRADE MARK

R-P&C Valve Division
AMERICAN CHAIN & CABLE

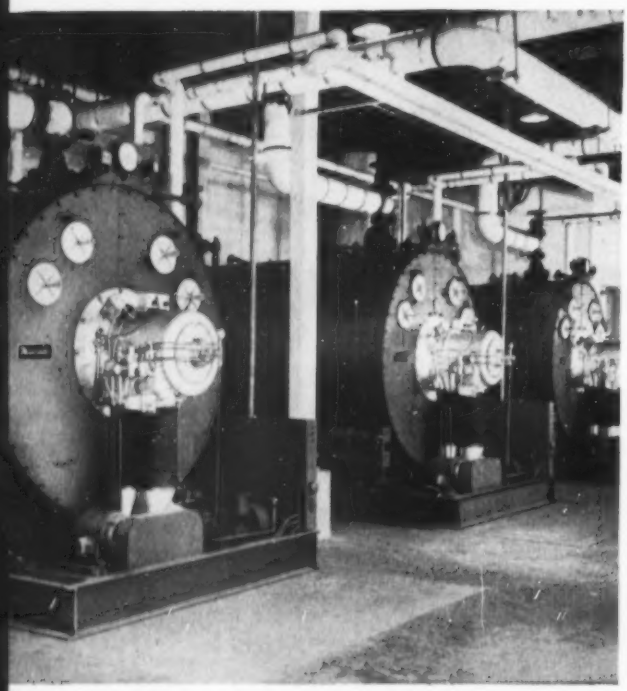
Reading, Pa., Atlanta, Baltimore, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

R-P&C valves

New.. Powermaster®

exclusive....

Now . . . for the *first time* you can get packaged boiler units in the wide range of capacities from 15 to 500 HP, with *complete interchangeability of fuels* . . . light or heavy fuel oil—natural or manufactured gas—or combination gas and oil . . . and you get this cost-saving advantage *only* with *Powermaster* Packaged Automatic Boilers. Find out more about this new, wide-range service today from your *Powermaster* representative. He will help you with recommendations and suggestions for selecting the most economical units to supply steam or hot water requirements in any kind of service—industrial plants, institutions, public buildings, schools, laundries, apartment houses, hospitals, dairies, motels, and shopping centers.



Model 3 *Powermaster*—Experienced-proved to be the standard of industry. These three 350 HP units are supplying process steam at pressures up to 200 psi. with rapid response to load changes.

- Complete Fuel Flexibility:
  Light or Heavy Oil, Any Gas or Combination Oil and Gas.
- Choice of:
  Air Atomizing VORIFLOW Oil Burner —Pre-Mix VORIFLOW Gas Burner—Combination VORIFLOW Oil and Gas Burner—All Designed and Built by O & S.
- Full-Range Modulation with VORIFLOW Combustion.
- All Middle-Range and Large Capacities.
- Selection of Automatic Operating and Safety Controls.
- Instant Change from Fuel to Fuel.

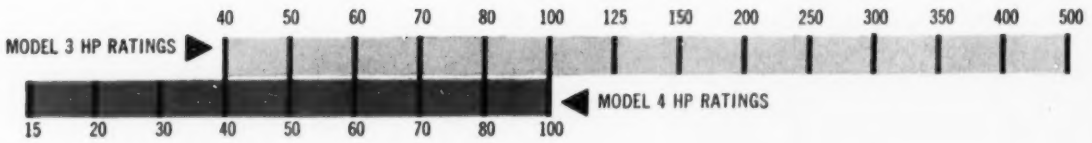
Send for bulletins describing Model 3 and Model 4 *Powermaster* units.

ORR & SEMBOWER, INC.
READING, PA.
BUILDING DEPENDABLE BOILERS SINCE 1885

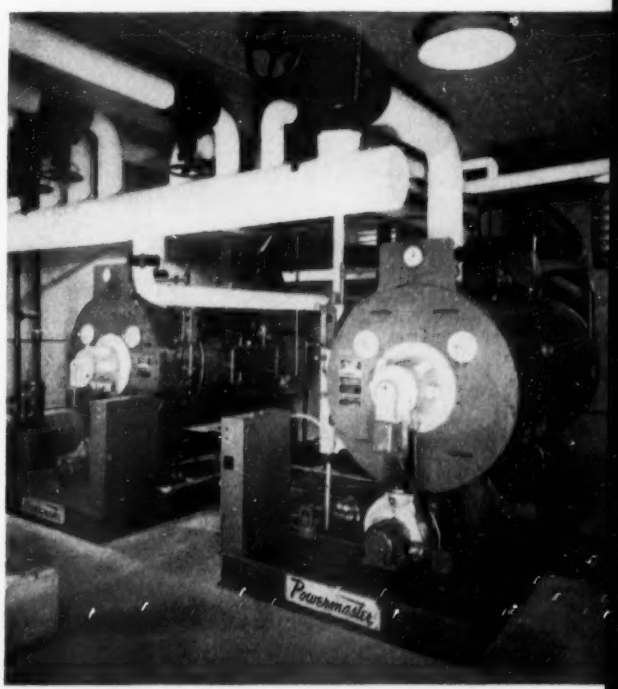
. . a choice of 2

Powermaster Packaged Automatic Boilers to meet your specific operating requirements . . . to your best advantage.

for 15 to 250 psi. steam or hot water



Model 4 Powermaster—Service-proved in wide variety of successful applications. These 40 HP units supply 15 psi. steam for heating. Simplicity of operation and controls is an important advantage.

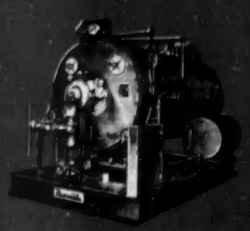


- Choice of Fuels:
  Light Distillate—Natural Gas—Manufactured Gas—Combination Oil and Gas.
- Choice of:
  Mechanical Pressure Atomizing Oil Burner—Pre-Mix Gas Burner—Combination Oil and Gas Burner—All Designed and Built by O & S.
- Simple On-Off and Low-Fire Start Burners.
- Small and Popular Middle-Range Capacities.
- Selection of Automatic Operating and Safety Controls.
- Quick Change from Fuel to Fuel.

O&S

Powermaster®

PACKAGED AUTOMATIC BOILERS



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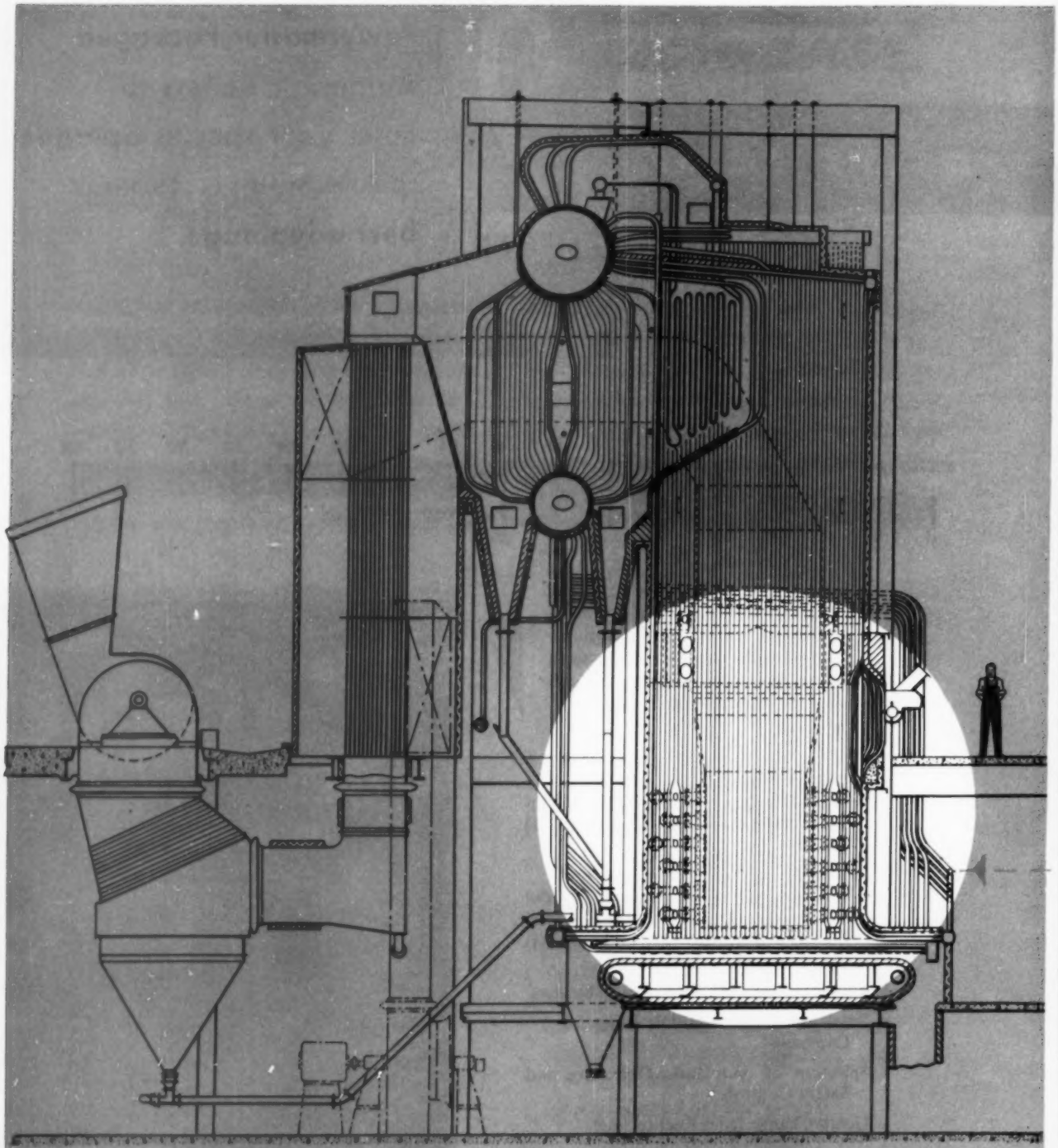


The C-E Bark-Burning Unit shown above is designed to produce 125,000 pounds of steam per hour at 875 psi and 825 F when fired with bark, and is arranged for the use of oil or gas as alternate fuels.

BOILERS, FUEL BURNING & RELATED EQUIPMENT; PULVERIZERS, AIR SEPARATORS & FLASH DRYING SYSTEMS; PRESSURE VESSELS, AUTOMATIC WATER HEATERS; SOIL PIPE

NOW BARK HAS LOST ITS BITE

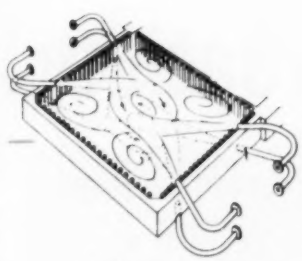
There is no doubt about it — the disposal of bark has always posed a serious problem, particularly to the paper pulp and lumber industries. Bulky, dirty, and moisture-laden, this ever-present waste material accumulates in veritable mountains at many mills and has generally been regarded as a headache.

Sure — it can be burned and — until recently — has been, in cumbersome dutch oven furnaces with much difficulty and inefficiency.

Now — with the availability of the C-E Bark-Burning Unit — "bark has lost its bite." The secret is turbulent, suspension burning as illustrated on the opposite page and described below.

This eminently successful unit is but another in a growing list of C-E developments which have solved difficult problems in the field of fuel burning and steam generation. Outstanding improvements in the methods of burning bagasse, furfural residue, black liquor and lignite, as well as the easy disposal of sewage and industrial wastes — to mention but a few — have not only proved practical but highly profitable.

So if you burn bark, waste wood or other cellulose fuel, investigate the exceptional advantages of the C-E Bark-Burning Unit. Operating installations in various parts of the country are demonstrating its exceptional reliability and efficiency day after day, month in and month out. The experience and engineering competence of the C-E staff are freely available to you and your consultants.



HERE'S HOW IT WORKS . . .

Bark, wood waste, or other cellulose fuel is introduced into the furnace by special spreader units located considerably above grate level. At the same time, extreme turbulence is produced in the furnace by blowing tangentially directed streams of preheated air through rows of nozzles at various furnace levels as shown in the sketch above. On each alternate level the tangential action is in the opposite direction.

Thus the fuel is fed into a zone of violently swirling air, preheated to a temperature of several hundred degrees. Under these circumstances, moisture evaporates almost instantly — and nearly all of the flash-dried fuel burns in suspension. The remainder falls to the grate in an even layer, where it is quickly consumed.

Both Eastern and Western waste woods are being burned with complete satisfaction by this Combustion equipment, and at substantial savings over any previous method.

B-747

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Combustion Engineering Building, 200 Madison Avenue, New York 16, N. Y.

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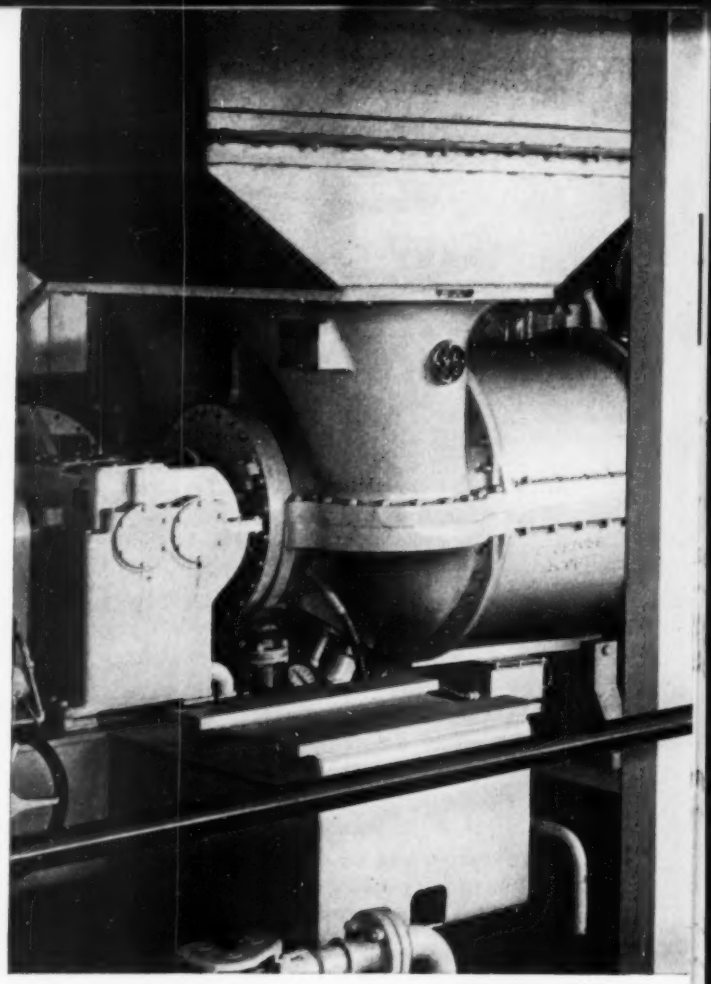
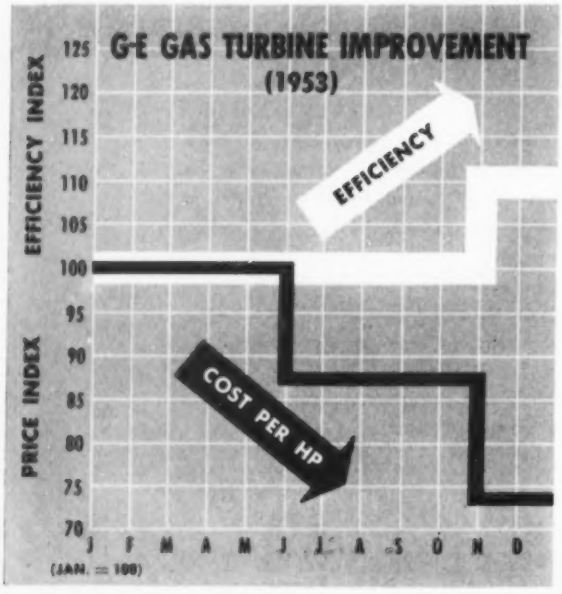
GAS TURBINE

progress report

In the past year, G-E engineers have reduced the cost per hp of the G-E gas turbine—and boosted its efficiency an average of 11 per cent. You may be able to put this versatile prime mover to work providing low-cost power for your plant.



Increased Efficiency, Versatility,

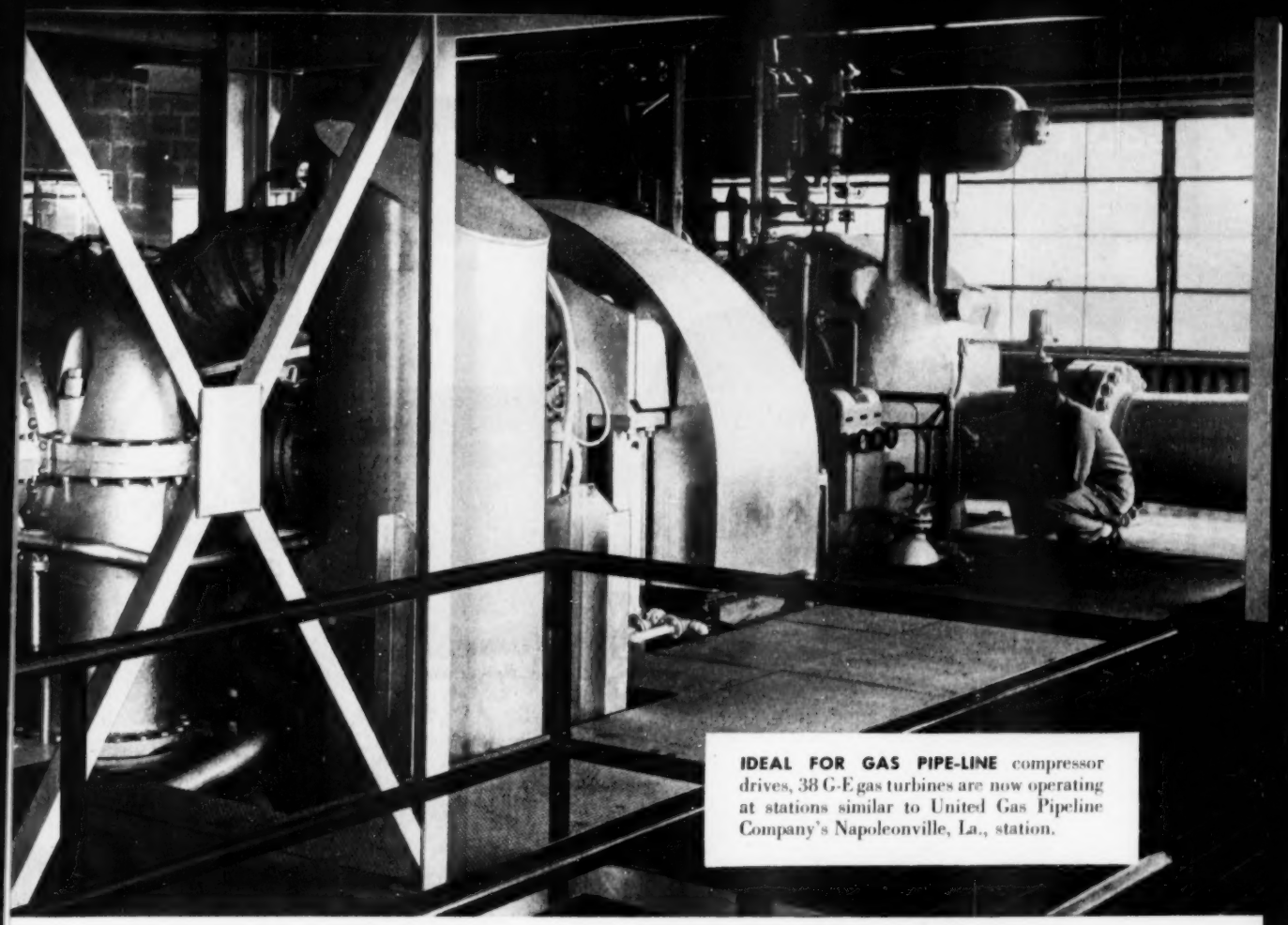


GREATER EFFICIENCY AND LOWER COST PER HP, achieved by improved design and manufacturing techniques, were significant G-E gas-turbine advances in 1953.

G-E GAS TURBINE OPERATING RECORD
(As of March 15, 1954)

TYPE OF SERVICE	NO. OF UNITS	OPERATING HOURS
LOCOMOTIVES	11	60,000
POWER GENERATION	16	70,000
GAS PIPE-LINE PUMPING	38	150,000
PETRO-CHEMICAL	1	3,000
TOTAL	66	283,000

UNEQUALED RECORD for operating hours and diversity of application, shows versatility and dependability of G-E gas turbine, gives G-E engineers vital data for future progress.



IDEAL FOR GAS PIPE-LINE compressor drives, 38 G-E gas turbines are now operating at stations similar to United Gas Pipeline Company's Napoleonville, La., station.

Lower Cost Per Horsepower Mark G-E Gas-turbine Progress

In less than five years, what was a completely new, un-tried prime mover has been shaped into a dependable, economical means of power. Already G-E turbines have racked up over 280,000 hours driving railroad locomotives, generating electric power, and turning high-speed compressors for gas pipe-line pumping and other industrial processes.

In the past year alone, G-E engineers have reduced the cost per horsepower for the gas turbines an average of 26 per cent. In the same short span, they have boosted efficiency an average of 11 per cent.

Outstanding among recent improvements is an integral base on which the turbine and its auxiliary equipment are permanently mounted and shipped—substantially reducing installation costs.

How could all this happen? General Electric, leader in the design and manufacture of both steam turbines and jet engines, was well equipped to develop the combustion gas turbine. Now, with thousands of hours of operating experience already accumulated, and with a factory designed exclusively for their manufacture, G.E. is leading the way in the gas turbine field.

If you would like more information on the gas turbine, contact your nearest G-E Apparatus Sales Office or write to General Electric Company, Section 255-10, Schenectady 5, New York.

You can put your confidence in—

GENERAL ELECTRIC

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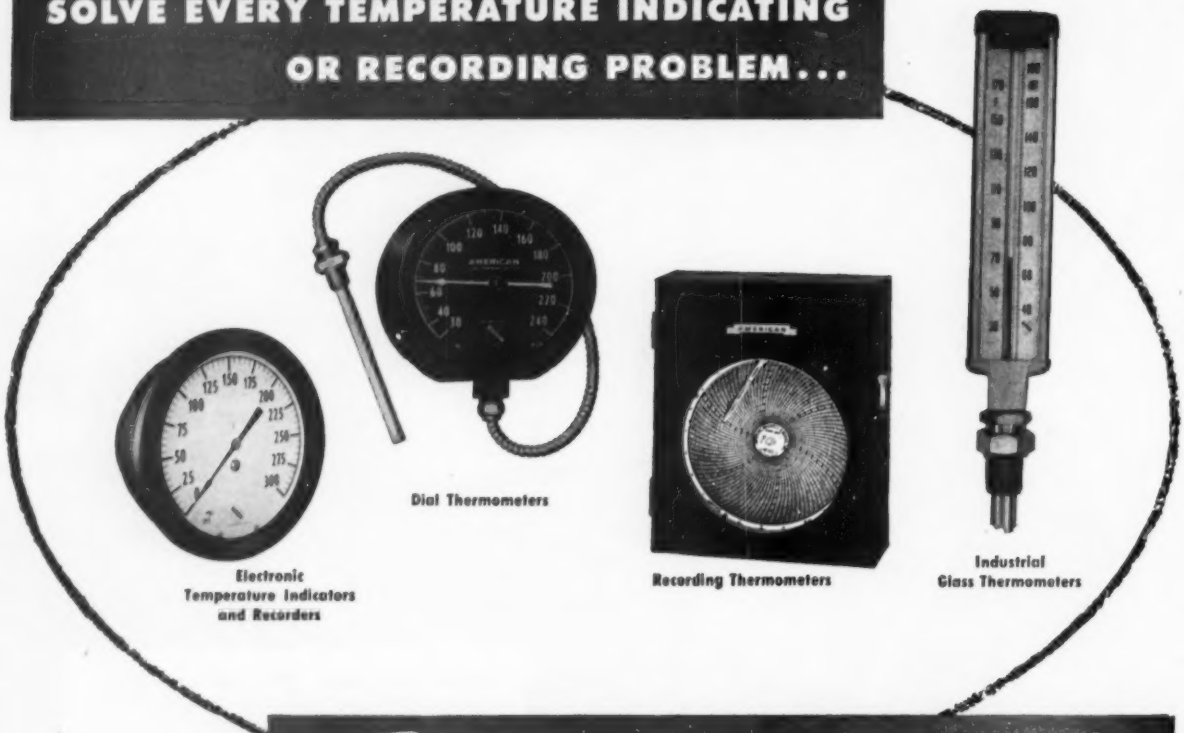
SOLVE EVERY TEMPERATURE INDICATING OR RECORDING PROBLEM...



Electronic Temperature Indicators and Recorders

Dial Thermometers

Recording Thermometers

Industrial Glass Thermometers

Specify AMERICAN THERMOMETERS

Maintenance of product quality . . . precise cost control . . . protection of equipment. For whatever reason consistently accurate temperature indication or recording is vital to your operations, choose the best — American Thermometers and Temperature Measuring Instruments.

Unlimited application — determined by the type of instrument and requirements — is evident in the following broad specification information:

TEMPERATURE RANGES: Minus 100°F. to plus 3000°F.

TYPES OF ACTUATION: Mercury, vapor pressure, gas, bi-metal and thermocouple.

REMOTE INDICATION OR RECORDING: For measurements up to 250 feet from the temperature source, accurate mercury-actuated instruments are available with famous "Magic Pulse" self-compensating capillary tubing. To indicate or record process temperatures at one or more points a considerable distance from the temperature source, American Temperature Transmission Systems provide maximum accuracy.

Materials of the highest quality, advanced design, and precision workmanship assure perfect performance in the severest applications. The wide variety of types, temperature ranges, and means of actuation make it easy to select the proper American Thermometers and Temperature Measuring Instruments for your specific needs. Write for catalog.

FOR THE BEST SERVICE, buy through your Industrial Supply Distributor. He has the experienced organization and carries adequate stocks to meet your most exacting requirements and at low cost.

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MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'HANCOCK' VALVES, 'ASHCROFT' GAUGES,' CONSOLIDATED' SAFETY AND RELIEF VALVES, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

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"33,000 HOURS proved the choice was right!"

When a prominent North Carolina community converted its power plant to diesel operation, it called in Sinclair Lubrication Engineer Jim Holt for his recommendations on proper lubricants.

Mr. Holt reports, "I recommended Sinclair RUBILENE®. My previous experience convinced me that this diesel lubricating oil would provide maximum wear protection for this power plant's six 1000 K.W. diesel engines. RUBILENE also guards against sticking rings and prevents excessive wear of cylinders, pistons and other moving parts operating continuously for long periods.

"RUBILENE was the right choice," Mr. Holt continues. "After 33,000 hours of near-continuous operation, bearings show very little discernible wear – and there's not a sign of erosive or corrosive action. *Oil consumption is remarkably low,* considering the prolonged operating hours under overload. All six 1000 K.W. engines, with a total output of 6400 K.W. per hour, *use a total of only 1 barrel of oil a day!*"

Why not give a Sinclair Lubrication Engineer the chance to help solve *your* lubrication problem. *There's no obligation.* Contact your local Sinclair office or write Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

SINCLAIR DIESEL LUBRICANTS

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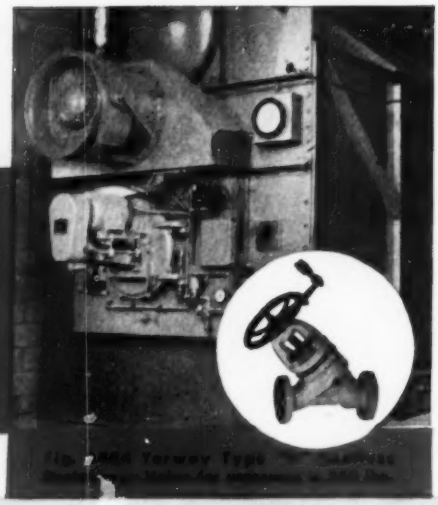
YARWAY MARCHES IN THE KEELER "PACKAGE" PARADE



● Among other marks of quality on package boilers that "roll out" of E. Keeler Company's plant—are Yarway Blow-Off Valves.

Keeler knows what many other boilermakers know . . . that a *good* package-type boiler is *better* when equipped with Yarway Seatless Blow-Off Valves.

Over 15,000 boiler plant operators also know and appreciate Yarway Blow-Off Valves . . . their simplified design, dependable operation, long life, low cost maintenance.

Want more details? See Yarway Bulletin B-426.

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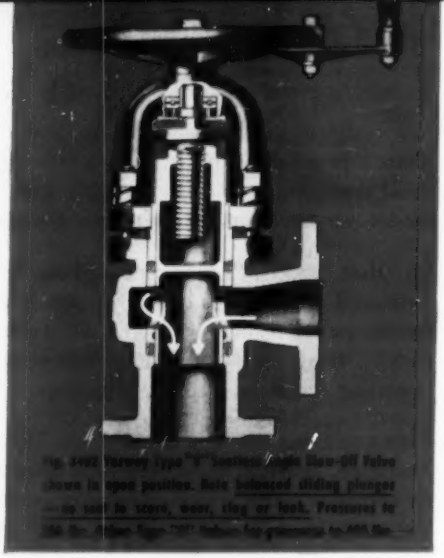

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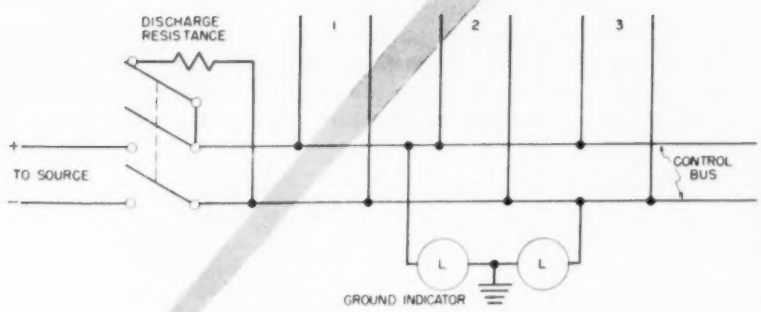


Fig. 1. Usual method of providing control current is to tap bus at the most convenient points without considering the advantages of being able to isolate circuits at later date when fault finding

With Fault Isolating Switches

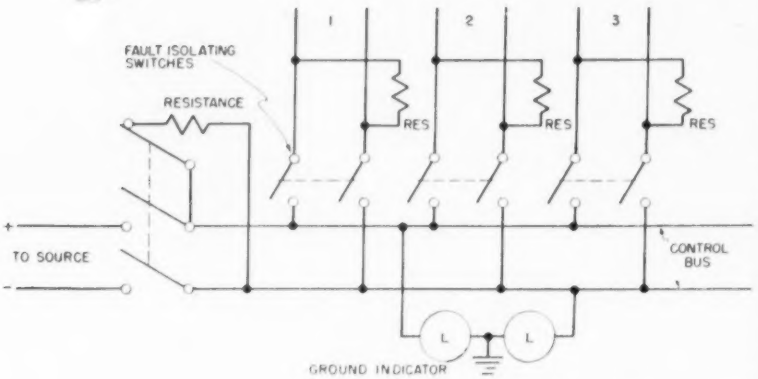


Fig. 2. Installing disconnect switches to isolate sections of a control wiring system greatly eases the work of locating faults in future years. Both polarities should be disconnected by each switch

Segregate Control Circuits

By E. H. STIVENDER *

A few isolating switches in the proper places will save you a lot of time, trouble and money when locating ground faults

ONE of the most irritating troubles for the maintenance electrician is the ground fault in a control system. When a "ground" is known to exist, it seldom requires immediate shutting down of the power equipment but it must be removed as early as possible because of the likelihood of more serious trouble later, such as the occurrence of a similar fault of opposite polarity.

Those concerned with maintenance know well the effort and time which can be consumed in a search for the point of fault, and with the increasing use of automatic control these problems will keep increasing.

The usual way to locate a ground fault is to wait until the power equipment is shut down, then in the limited time allowed, painstakingly isolate one circuit after another by unbolting, and separating connections progressively or at random, continually checking with test lamps, voltmeters, magnetos, meggers or battery-bell sets, until by the process of elimination the faulty circuit is isolated, the fault found and corrected, then going back and restoring the disconnected circuits. Maybe during this process the fault will appear to change from one polarity to the other because of the changes in relative resistance. During these times one wishes very much that some permanently installed isolating switches had been installed to quickly limit the possible location to a small number of circuits.

Figure 1 shows a simple control supply layout using d-c. Ground indicating lamps are shown connected to the control bus. The branch wiring 1, 2, 3 is connected solidly to the bus and farther out there will probably be many connections for other apparatus, wherein one polarity will come from one branch and the other polarity from another branch. This arrangement is all right until faults appear.

Figure 2 shows the same kind of system with isolating switches in each of the three branches 1, 2, 3. If there are no interconnections between branches farther out, as mentioned above, the installation of these switches is simple. If there are, and that seems to be usual unless early precautions are taken, they must be changed to get true isolation and thereby the full benefit of the isolating switches. This is frequently hard to do after an installation is completed.

Switches should be regular knife switches with no fuses. Fuses for this application are likely to cause more trouble than they would prevent. The resistors shown connected in each branch are for discharge protection, to prevent high momentary voltages when a switch is opened in an inductive circuit. Their value in ohms should be roughly two or three times the circuit resistance during operating conditions. They must be rated for continuous duty. The main switch at the left is shown with discharge contacts to take care of highly inductive shunt field circuits. This discharge resistance should be about twice the resistance of the complete circuit and have a current rating equal to that of the circuit but with five or ten seconds time duty rating. (Resistor banks in the load circuit, such as those for d-c motor starting, need not be considered because they are noninductive.)

In selecting the loads to be grouped on a given isolating switch, there is no preferable pattern. In general, the more isolating switches, the better for the maintenance man, but there is a reasonable limit. Schemes used have put trip circuits on one switch, closing circuits on another, field circuits on another and miscellaneous on another. This is done only in order to give names to the branch circuits. Any other grouping is equally good so long as the branches are truly isolated in *both* polarities when a switch is opened. Fig. 3 is an example. The switches should be plainly marked with a diagram conveniently at hand to quickly determine what circuits are being disconnected when a given switch is opened.

* Consulting Engineer; Fellow, A.I.E.E.

Caribou Integrates Steam,

New 125,000-lb-per-hr pressurized oil-fired boiler and 12,650-kw turbine generator added to interesting installation at Caribou, Maine, where a small steam plant, a diesel plant and a hydro plant sit side by side and provide reliable and economical power over 3600 sq miles in northeastern Maine and New Brunswick

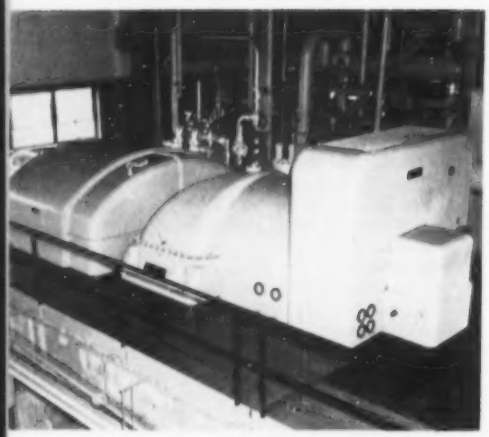


Fig. 1. Caribou No. 1 turbine generator, 7500 kw

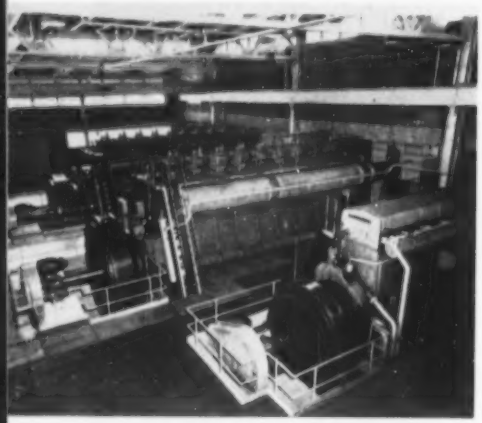
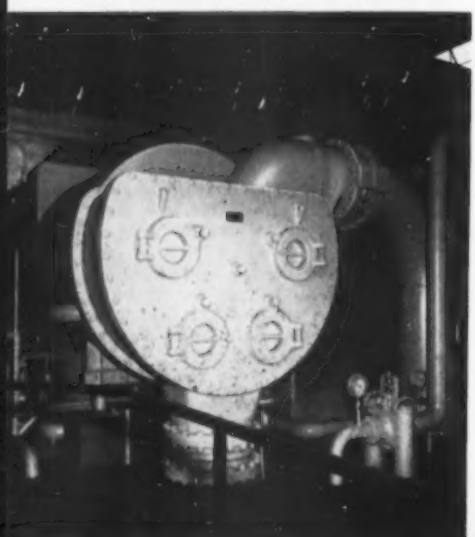


Fig. 2. Three of the five diesels in Caribou plant

Fig. 3. Condenser for the No. 1 turbine generator



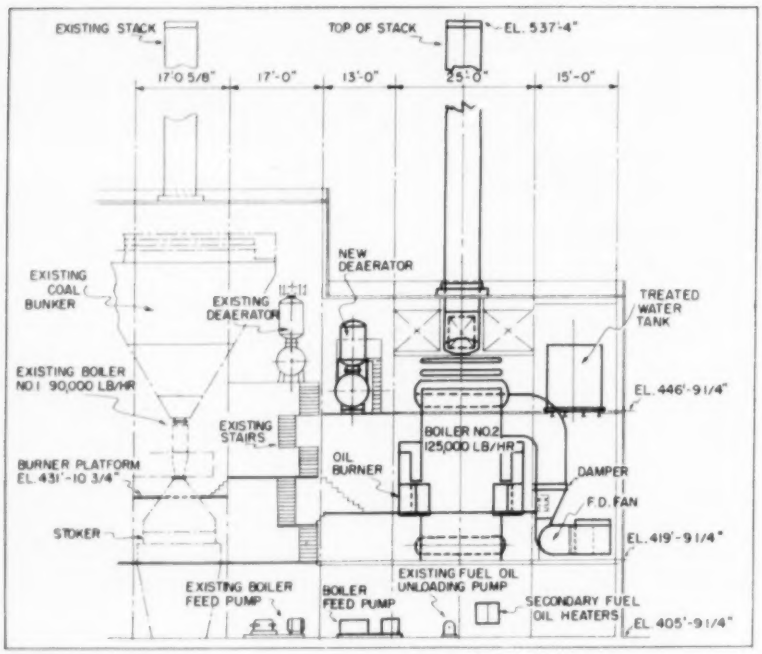


Fig. 4. Longitudinal section showing existing boiler No. 1 and new pressurized boiler Unit No. 2

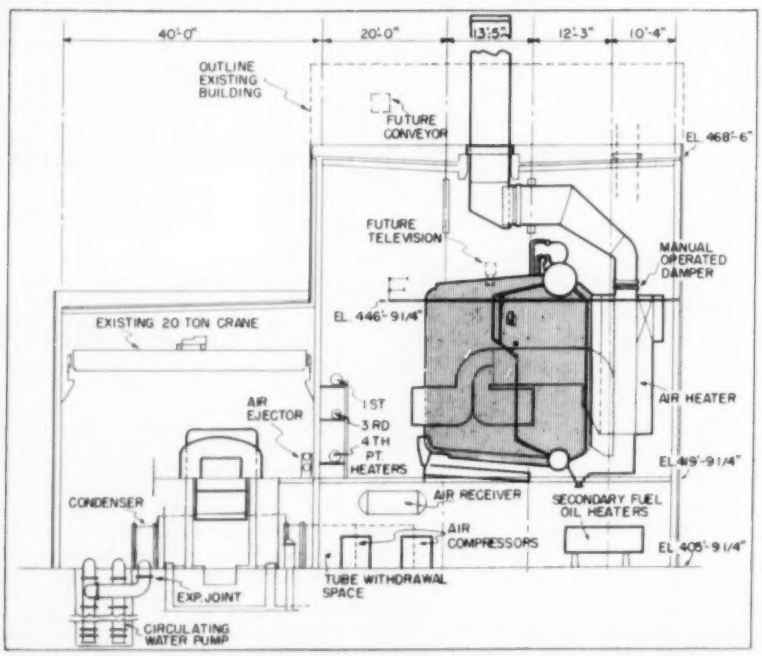


Fig. 5. Cross-section through boiler Unit No. 2 and turbine-generator No. 2 soon to be installed

Diesel & Hydro

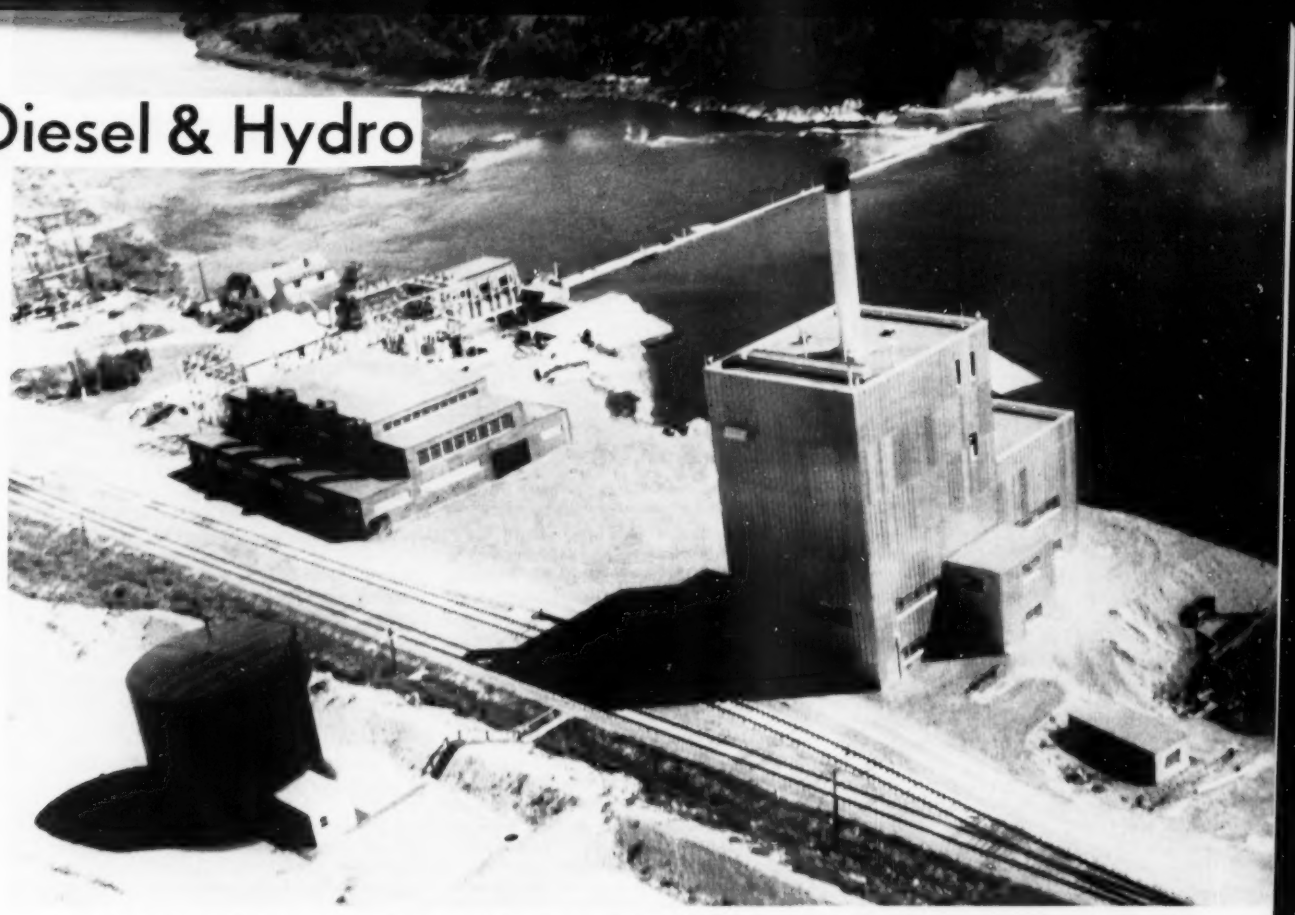


Fig. 6. At Caribou, Maine, here are the 1000-kw hydro plant, out near end of dam, 8100-kw diesel plant left center, 7500-kw steam plant right in which second 12,650-kw unit will soon be in service. This side-by-side, three plant development is unusual, has many operating advantages. It feeds a large area

By M. S. BLACKWELL*

ONE OF the most unusual and interesting utility power developments in the country is that of Maine Public Service Company at Caribou, Maine, about 11 miles northeast of the company's headquarters, at Presque Isle, Maine. The Caribou installation consists of three generating stations located right alongside each other on the bank of the Aroostook River at Caribou, as shown in Fig. 6. These are: a 7500-kw steam electric generating plant where a new unit is being installed, a 10,000-hp diesel engine plant and a 1000-kw hydroelectric plant.

These plants all feed power into the company's system, which serves an area of about 3600 square miles in the northeastern part of Maine, including the famous potato-growing county of Aroostook. The system also supplies power to part of New Brunswick through a subsidiary company, Maine and New Brunswick Electrical Power Co., Ltd., which has a hydroelectric plant at Tinker on the Canadian side of the Aroostook River about 3 miles from Fort Fairfield. On the south, there is an interconnection with the Bangor Hydroelectric Co. system.

At present, one of the most important developments in the system is the expansion of the Caribou steam plant, on which construction will begin this spring. This incorporates some unusual features that will be described.

At the Tinker hydro plant, two of the 2000-hp water wheels have been rebuilt by their manufacturer in such a way that each will deliver 150 kw more than before. This remodeling involves an interesting method of modifying the speed rings of the units without removing them from their settings and this will be described in a subsequent article.

The dam at Caribou, originally built in 1887, was completely rebuilt in 1950–1953 and this too will be described in another article.

The part of the Caribou development that arouses greatest interest among power engineers is the new steam station, the first unit of which went into operation in 1950. It contains a single 7500-kw steam turbine generator supplied with steam by a single boiler. The station is extremely attractive both inside and out. Exterior is of fabricated insulated aluminum panels with wide vertical flutings. The self-supporting steel stack, mounted on the roof, is painted with aluminum.

The interior of the station is very attractive with walls and all equipment painted a leaf green, tomato red concrete floors and hand-rails enameled black. There is no division between boiler and turbine room; the operators supervise all operations from control panels between boiler and turbine. All equipment is laid out with plenty of space for convenience in operation and maintenance and proper stairways and gratings for good access to all parts.

The existing steam station, completed in 1950, was described in detail by Edward H. Barry, mechanical engineer in charge of design for Stone & Webster Engineering Corp., designers and constructors of the station, in an article in *Powerfax*, Autumn 1951 and also in *Combustion*, November 1951. The latter includes a complete list of equipment.

General arrangement of the existing station is shown in Figs. 1, 4 and 5. The turbine generator is a standard Elliott 7500-kw, 9375-kva, 0.8-pf, 13,800-v, 3-phase, 60-cycle, 3600-rpm machine with direct-connected exciter. It is supplied with steam at 600 psi, 825 F by a Combustion 90,000-lb-per-hr two-drum bent-tube

*Vice-President and General Manager, Maine Public Service Co., Presque Isle, Maine.

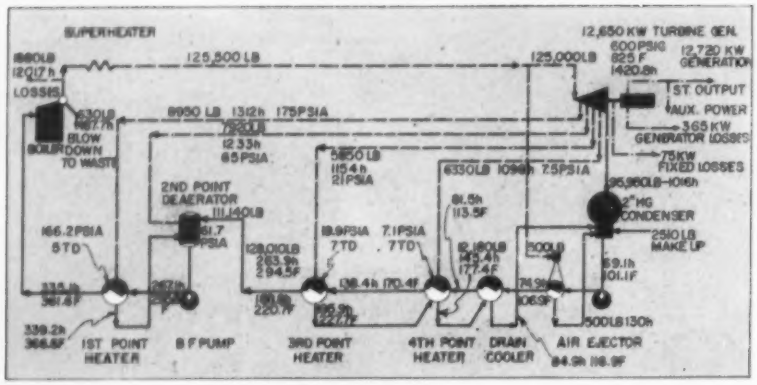


Fig. 7. Here is the heat balance for the proposed new 12,650 kw Unit No. 2 at Caribou. It is simple, shows four stages of extraction feed heating including deaerator but without employing an evaporator

boiler with its water-cooled furnace.

The existing boiler and plant are designed so that coal can be burned if desirable in the future. Overhead coal bunker is installed and space left for installation of future coal-handling equipment. Below the unit space has been provided for future ash hopper and handling equipment. A spreader stoker is installed in this boiler.

Up to now, however, only Bunker C oil has been burned in this unit, using four mechanical atomizing burners with variable orifices and constant oil pressure, the burner operating levers being interconnected mechanically for operation by the combustion control.

Steam Air Heater

On the forced draft fan, inlets are arranged so that air can be drawn from outside the building in winter and warmed by a steam air heater, to prevent heater corrosion of the tubular flue gas air heater. In summer, air is drawn from inside the building to aid ventilation. A mechanical dust collector is installed, the internals of which have been omitted until such time as the boiler operates on coal.

The main turbine condenser is shown in Fig. 3. Feedwater heating is by three extraction heaters and the boiler economizer, final feed temperature being 350 F. Two boiler feed pumps supply the boilers. Make-up is treated by a zeolite softener. All auxiliaries are motor driven.

Second Unit Design

In designing the second unit for this steam plant, Stone & Webster have incorporated some outstanding new equipment and some features designed to reduce costs. The building will be extended in the open space towards the diesel plant. A 10,000-bbl oil tank, formerly located between the steam and diesel plants, has been moved across the railroad track, by unique methods to be shown in another article. There is room in that space for the second unit and for a third future unit when needed.

The outstanding new feature will be a Combustion boiler designed for pressurized firing, see Figs. 4 and 5. This boiler will burn only oil; no coal burning equipment will be installed. Only a forced-draft fan will be used; no ID fan will be installed. A steam air heater will also be installed on this FD fan inlet, similar to that on the first unit. Although No. 1 boiler has an economizer, this equipment has been omitted from No. 2.

Although this second boiler will have a capacity of 125,000 lb per hr, about ⅓ more than the first boiler, it is smaller and lower, hence the building height and cost will be reduced. The second boiler will be supported on the steel work at the bottom and provision will be made for vertical and horizontal expansion of the entire unit.

Fuel Oil Burning

This second boiler will be equipped with tangential manually-tiltable combination mechanical and steam atomizing burners at the four corners of the furnaces. In this boiler, the firing rate will be controlled at all four burners at all loads within their range. Mechanical guns will be used during the heavier loads. At lighter loads, individual burners may be cut out or guns switched from mechanical to steam atomizing. Under either load condition the boiler will be under automatic combustion control. Tilting burners will help at all loads.

Variable return oil system will not be used. Control will be obtained by adjusting the pressure of the oil supply at the burners. Provision will be made for future installation of a wired television set which will enable the operator at the control panel to observe the burner flames. Bottled gas will be used for burner ignition. To supply air for sealing inspection doors against the pressure in the furnace, two new air compressors will be installed.

Bunker C fuel oil is stored in two 10,000-bbl tanks across the railroad tracks from the plant. A third 5700-bbl tank supplies fuel oil to the Diesel plant.

Oil is delivered by tank car or tank truck from which it is pumped underground to the steel storage tanks. It is withdrawn from these by a primary oil pumping and heating system and pumped through a secondary heating system to the burners. An automatic oil-fired package boiler supplies low-pressure steam to heat the station when steam extracted from the turbines is not available during shutdowns.

Turbine generator No. 2, like No. 1, will also be an Elliott unit but of 12,650 kw capacity. The two units will be arranged end to end, with steam ends facing each other, as in Fig. 8. Condenser, and extraction feedwater heater arrangement on the main operating floor will be essentially the same as for Unit No. 1.

Condenser circulating water for Unit No. 2, as for Unit No. 1, will be drawn from the river above the dam through an intake located in a small inlet from the river shown at the lower right in Fig. 6. Warm circulating water discharges downstream from the intake but above the dam. An electric fish screen protects the intake, *continued on page 130*

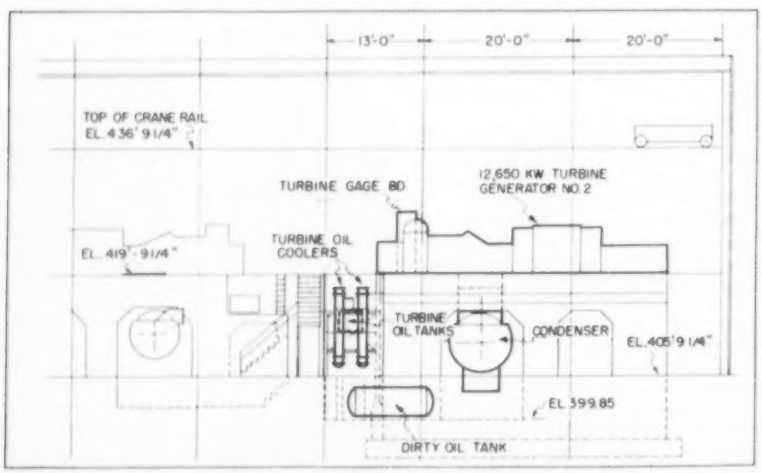


Fig. 8. Showing how new turbine generator No. 2 for Caribou will be end-to-end with Unit No. 1

Detect BF Pump Load-Drop Cavitation Mathematically

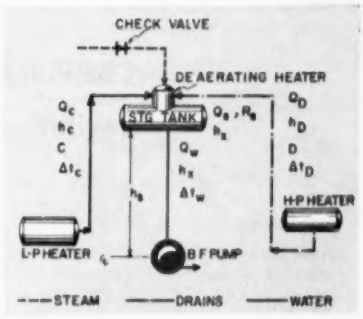


Fig. 1. Non-recirculating BF pump diagram relating areas of system with the factors in those areas (list in Table I)

Sudden load drops on steam turbines can lead to pressure decay conditions in the deaerating heater capable of causing cavitation in the BF pump. This article tells how to detect those conditions mathematically in a non-recirculating system and how to correct them. Next month an article will be devoted to the recirculating feedwater systems

By DR. S. BARON *

EFFECTS OF sudden load changes on centrifugal boiler feed pumps in steam turbine plants were described very clearly and concisely at the First Annual Meeting of the American Power Conference of 1952 in a paper presented by I. J. Karassik, G. S. Bosworth and B. J. Schmid. It was apparent that a mathematical treatment of this behaviour would be valuable to steam designers since it would permit investigation of their own systems without experimentation.

This article presents such a mathematical analysis for non-recirculating pump systems by means of equations derived for pressure decay in the deaerating heater. These equations permit direct solutions for the heater pressure required to prevent cavitation conditions, and also solve for actual heater pressures for the same time intervals.

Effect of Load Drop

Before considering the mathematical aspect of the problem, it would be helpful to review the system's behaviour under sudden load drop. Abrupt reduction of load on the turbine would result first in a sudden drop in turbine stage pressures. The steam bleed line from the turbine to the deaerating heater is equipped with a check valve which prevents overspeeding of the turbine through feedback of steam in the heater, so heat stored in the heater cannot be dissipated rapidly by flashing. Heater pressure would decay (or gradually diminish), however, because the inflows of condensate from the low-pressure heaters and drains from the high-pressure heaters will eventually be cooler and will decrease the heater temperature and vapor pressure.

Conditions at the boiler feed pump inlet will lag behind those in the heater because of the so-called "residence time" of water in the suction piping. This means that water entering the pump during this period will have one vapor pressure while that in the heater will have some lower vapor pressure, hence a lower heater pressure. If this difference in pressures is great enough to cause the actual NPSH (net positive suction head) at the pump inlet to fall below the required value for that pump operating at that inlet temperature, cavitation can be expected in the pump. At its best, this means limitation of pump capacity and severe vibration. If the amplitude of vibration exceeds the running clearance, galling and seizure of the rotating parts can result.

If the mathematical analysis indicates that cavitation conditions exist, recommendations at the end of this article will help in planning design changes without resorting to expensive experimentation.

Assumptions

Certain reasonable assumptions must be made concerning the behaviour of the system during load drops if that behaviour is to be expressed mathematically. These assumptions are:

1. Condensate, drain and feedwater flows immediately change to their designed or expected flow rates at the instant the load drops.

2. Enthalpies of condensate and drain flows will remain at the high-load condition until water in the lines at load drop has had time to flow into the heater. From this time on, their enthalpies will be at the low-load condition. The time for the volume of each line to flow through that line at its low-load rate is its *residence time* (Δt), and the residence times of the two lines are not necessarily the same.

3. Mean enthalpy in the feedwater storage tank during pressure decay in the heater corresponds to that at a

*Burns and Roe, Incorporated, Engineers and Constructors, New York, N.Y.

Table I. Factors used in calculation of pressure decay and cavitation condition in non-recirculating feedwater system. Source data is given in notes

Factor	Source (See Notes)	Description
Q_D	1	Volume of drain piping from h-p heater following deaerator, to the deaerator (cu ft).
Q_c	1	Volume of condensate piping from l-p heater before the deaerator, to the deaerator (cu ft).
Q_s	1	Volume of suction piping from deaerating heater storage tank outlet to BF pump inlet (cu ft).
Q_w	1	Volume of water in storage tank (cu ft).
D	2	Drain flow from h-p feedwater heater (lb per hr).
C	2	Condensate flow from l-p heater to deaerating heater (lb per hr).
W	2	Feedwater flow (lb per hr).
h_D	2	Enthalpy of h-p heater drains (Btu per lb).
h_c	2	Enthalpy of condensate (Btu per lb).
h_s	2 and 5	Enthalpy of feedwater in storage tank (Btu per lb).
R_s	4	Density of feedwater in the storage tank (lb per cu ft).
P_s	5	Heater pressure, actual or required as noted (psia).
P_{vp}	4	Vapor pressure of feedwater at BF pump inlet (psia).
NPSH	3	Net positive suction head required (ft).
h_s	1	Static head at pump inlet less pressure drop in suction piping (ft).

General Subscripts:
G = High-load condition.
L = Low-load condition.
c = Condensate condition.
D = Drains condition.

Notes: Sources of data.
1. Data from plant layout drawings.
2. Data from plant feedwater heat balance.
3. Data from pump performance information.
4. Data from saturated steam tables.
5. Calculated (see Table II).

. . . . Detect BF Pump Cavitation

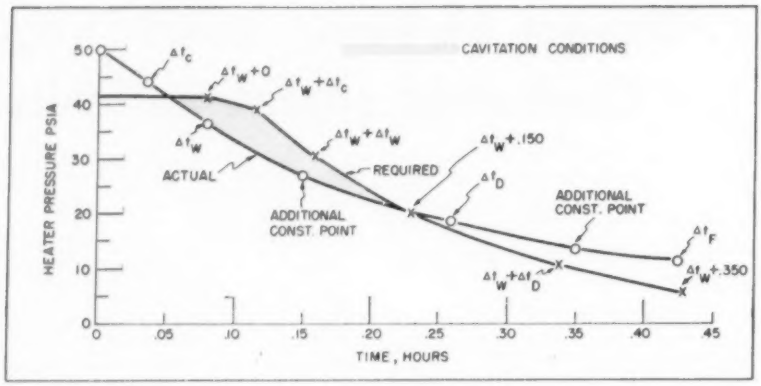


Fig. 2. Results of example in Table IV show actual pressure below required between 0.05 and 0.225 hr

Table II. Equations for the solution of progressive pressure decay in a non-recirculating system when its residence time Δt_D is longer than the time Δt_c

Equation 1. Enthalpy in storage tank from $t = 0$ to $t = \Delta t_c$ expressed in Btu per lb. (At $t = \Delta t_c$, $h_x = h_{xc}$.)

$$h_x = (h_{xO} - \frac{K_2}{K_1})e^{-K_1 t} + \frac{K_2}{K_1}$$

Equation 2. Enthalpy in storage tank from $t = \Delta t_c$ to $t = \Delta t_D$ expressed in Btu per lb. (At $t = \Delta t_D$, $h_x = h_{xD}$.)

$$h_x = (h_{xc} - \frac{K_3}{K_1})e^{-K_1 \Delta t'_T} + \frac{K_3}{K_1}$$

in which $\Delta t'_D = \Delta t_D - \Delta t_c$.

Equation 3. Enthalpy in storage tank from $t = \Delta t_D - \Delta t_F$ expressed in Btu per lb. (At $t = \Delta t_F$ $h_x = h_{xF}$.)

$$h_x = \frac{(h_{xD} - \frac{K_4}{K_1})e^{-K_1 t}}{e^{-K_1 \Delta t_D}} + \frac{K_4}{K_1}$$

Equation 4. Simplified equation for enthalpy in storage tank throughout pressure decay, or from $t = 0$ to $t = \Delta t_F$, expressed in Btu per lb.

$$h_x = (h_{xO} - \frac{K_5}{K_1})e^{-K_1 t} + \frac{K_5}{K_1}$$

Equation 5. Factor expressed as reciprocal of hour.

$$K_1 = \frac{(D_L + C_L)}{Q_w R_s}$$

Equation 6. Factor expressed as Btu per lb-hr.

$$K_2 = \frac{(C_L h_{cO} + D_L h_{DO})}{Q_w R_s}$$

Equation 7. Factor expressed as Btu per lb-hr.

$$K_3 = \frac{(C_L h_{cL} + D_L h_{DO})}{Q_w R_s}$$

Equation 8. Factor expressed as Btu per lb-hr.

$$K_4 = \frac{(C_L h_{cL} + D_L h_{DL})}{Q_w R_s}$$

Equation 9. Required heater pressure expressed in psia.

$$P_s \text{ (required)} = (NPSH - h_s)\frac{R}{144} + P_{vp}$$

Equation 10. Residence time of condensate piping expressed in hours.

$$\Delta t_c = \frac{Q_w R_{cO}}{C_L}$$

Equation 11. Residence time of drains piping expressed in hours.

$$\Delta t_D = \frac{Q_D R_{DO}}{D_L}$$

Equation 12. Residence time of feed pump suction piping expressed in hours.

$$\Delta t_w = \frac{Q_w R_s}{W_L}$$

point midway between the top water level in the tank and the tank outlet. Enthalpies at the surface and at the outlet differ from the mean enthalpy by their hydrostatic heads. (Enthalpies of the water at different pressures are obtained from the saturated steam tables.)

4. The density and level of feedwater in the storage tank is constant during the decay time of the deaerating heater pressure.

Equation Factors

Factors entering into the equations are listed and identified in Table I. Some of these factors and their effects need further explanation, however, if their importance is to be appreciated. Residence times for condensate and drain lines, for example, are important because the rate of cooling and thereby pressure decay increases as each of these times is passed. Consider a case when the condensate residence time is less than that of the drains. At the residence time of the condensate line (Δt_c), the total flow into the heater changes from a mixture of condensate and drainage both at their high-load temperature to a mixture of condensate at its low-load temperature and drainage at its high-load temperature. At the residence time for the drain line (Δt_D), the flow into the heater becomes a mixture of both flows at their low-load temperatures.

In cases when the residence time of the drains is less than the condensate, the total flow at Δt_D consists of a mixture of condensate at high-load temperature and drains at low-load temperature. Finally at Δt_c, the total flow is a mixture of condensate and drains at the low-load temperature.

Residence time in the pump suction piping (Δt_w) is most important because a given enthalpy in the heater at a given time is characteristic of the enthalpy at the pump suction after a lapse of time equal to Δt_w. Total decay time (Δt_F) is that time at which the mean enthalpy of the heater becomes stabilized at low-load conditions after a load drop. It is not calculated directly, incidentally, but is obtained by substituting the known value of final enthalpy and other known data into Equation 3, Table II.

It will be noticed that in Table II there are several different equations for the solution of enthalpies. The enthalpies noted, however, are for different time intervals and are based on conditions existing when Δt_c is less than Δt_D. Equation 1 solves for h_{xc}, and can only be applied for values of Δt between $t = 0$ and $t = \Delta t_c$. Equation 2 solves for h_{xD} and can only be applied for values of t between $t = \Delta t_c$ and $t = \Delta t_D$. Equation 3 solves for h_x and can only be used for values of t between $t = \Delta t_D$ and $t = \Delta t_F$, or the stabilized low-load condition.

Equation 4 in Table II represents a shortcut or simplified version of the preceding step-by-step calculations. It is applicable for all values of t between $t = 0$ and $t = \Delta t_F$. Though it is less precise, discrepancies between its results and those of the stepwise calculations are on the conservative side and are safe. *Turn to page 72*

Table III. Tabulated results of pressure decay calculations for non-recirculating pump in Table IV.

t (hrs)	h_x Btu/lb	P_x (psia)	P_s (actual) (psia)	P_{vp} (psia)	Temp. (F)	R (lb/cu ft)	Required NPSH (ft)	Required P_s (psia)	$t + \Delta t_w$ (hrs)
0	250.0	50.0	50.0	50.0	281.0	57.8	18	41.2	.079
.0356	245.5	46.5	44.9	48.1	278.6	58.0	18	39.2	.115
.0790	233.0	38.1	36.5	39.7	266.8	58.3	17	30.4	.158
.150	216.0	28.6	27.0	30.2	250.7	58.8	16	20.4	.229
.259	196.1	20.0	18.4	21.6	232.1	59.3	15	11.3	.338
.350	182.2	15.3	13.7	16.9	219.1	59.6	14	6.1	.429
.425	173.0	12.8	11.2	....	.....	....	..	....	....

Table IV. Example showing the application of equations in Table II to a no-recirculating boiler feed pump system as the plant undergoes sudden load drop

EXAMPLE: A 40–44 MW turbine generator, 1250 psig, 950 F throttle conditions, operating at 44,000 kw, underwent a sudden load drop to 10,000 kw. Heat balances for this machine and its fw heating cycle provide the following data:

Fluids	Flow at 10 MW (lb per hr)	Enthalpy at 44 MW (Btu per lb)	Enthalpy at 10 MW (Btu per lb)
Condensate	$C_L = 80{,}000$	$h_{cG} = 198$	$h_{cL} = 132$
Drains	$D_L = 8{,}000$	$h_{GD} = 260$	$h_{DL} = 183$
Feedwater	$W_L = 88{,}000$	$h_{zG} = 250$	$h_{zL} = 173$

From the layout drawings of the unit, the following data are known: (Refer to Table I for meaning of symbols.)
$Q_c = 48$ cu ft; $Q_D = 36$ cu ft; $Q_w = 120$ cu ft; $Q_s = 500$ cu ft; $h_s = 40$ ft; level of water in storage tank = 8 ft. Assume average density constant and an average between initial and final conditions.

CALCULATIONS: With the preceding data, first calculate the values of factors required in the enthalpy equations then for required and actual pressures.

Step 1. Residence times Δt_c, Δt_D, Δt_w, and values for $\Delta t'_D$ are found as follows:

A. Residence time of condensate piping =

$$\Delta t_c = \frac{Q_c R_{cG}}{C_L} = \frac{48\left(\frac{1}{0.01684}\right)}{80{,}000} = 0.0356 \text{ hr}$$

B. Residence time in drains piping =

$$\Delta t_D = \frac{Q_D R_{DG}}{D_L} = \frac{36\left(\frac{1}{0.01737}\right)}{8{,}000} = 0.259 \text{ hr}$$

C. Residence time in boiler feed pump suction piping =

$$\Delta t_w = \frac{Q_w R_s}{W_L} = \frac{120\left(\frac{1}{0.01727}\right)}{88{,}000} = 0.079 \text{ hr}$$

D. Additional residence time of drains piping over condensate piping = $\Delta t'_D = \Delta t_D - \Delta t_C = 0.259 - 0.0356 = 0.223$ hr.

E. Additional residence time of suction piping over condensate lines = $\Delta t'_w = \Delta t_w - \Delta t_c = 0.079 - 0.0356 = 0.0434$ hr

Step 2. Find the average density of feedwater between initial and final feedwater enthalpies ($h_{zG} = 250$ Btu per lb and $h_{zE} = 173$ Btu per lb) as follows:

$$R_s = \frac{\left(\frac{1}{0.01667}\right) + \left(\frac{1}{0.01727}\right)}{2} = 59.0 \text{ lb per cu ft}$$

Step 3. Find the values for K_1, K_2, K_3, and K_4 as follows:

A. Constant $K_1 = \frac{(D_L + C_L)}{Q_s R_s} = \frac{80{,}000 + 8{,}000}{500 \times 59.0} = 2.98\left(\frac{1}{\text{hr}}\right)$

B. Factor $K_2 = \frac{(C_L h_{cG} + D_L h_{DG})}{Q_s R_s} = \frac{(80{,}000 \times 198 + 8{,}000 \times 260)}{500 \times 59.0}$
= 608 Btu per lb-hr

C. Factor $K_3 = \frac{(C_L h_{cL} + D_L h_{DG})}{Q_s R_s} = \frac{(80{,}000 \times 132 + 8{,}000 \times 260)}{500 \times 59.0}$
= 428 Btu per lb-hr

D. Factor $K_4 = \frac{(C_L h_{cL} + D_L h_{DL})}{Q_s R_s} = \frac{(80{,}000 \times 132 + 8{,}000 \times 183)}{500 \times 59.0}$
= 408 Btu per lb-hr

Step 4. Find the mean enthalpies of condensate and drains mixtures at $t = 0$, $t = \Delta t_c$ and $t = \Delta t_D$ as follows:

A. $\frac{K_2}{K_1} = \frac{608}{2.98} = 204$ Btu per lb

B. $\frac{K_3}{K_1} = \frac{428}{2.98} = 143.5$ Btu per lb

C. $\frac{K_4}{K_1} = \frac{408}{2.98} = 137$ Btu per lb

Step 5. Find the mean enthalpy in the storage tank at $t = \Delta t_c$, $t = \Delta t_D$ and $t = \Delta t_w$, as follows:

A. At $t = \Delta t_c$, $h_{xc} = (h_{xG} - \frac{K_2}{K_1})e^{-K_1 \Delta t_c} + \frac{K_2}{K_1}$

$= (250 - 204)e^{-(2.98 \times 0.0356)} + 204 = 245.5$ Btu per lb

B. At $t = \Delta t_D$, $h_{xD} = (h_{xc} - \frac{K_3}{K_1})e^{-K_1 \Delta t'_D} + \frac{K_3}{K_1}$ and $\Delta t'_D = 0.223$ hr, so

$h_{xD} = (245.5 - 143.5)e^{-(2.98 \times 0.223)} + 143.5 = 196.1$ Btu per lb

C. At $t = \Delta t_w$, $\Delta t'_w = 0.0434$ hr and $h_{xw} = (h_{xc} - \frac{K_3}{K_1})e^{-K_1 \Delta t'_w} + \frac{K_3}{K_1}$

$= (245.5 - 143.5)e^{-(2.98 \times 0.0434)} + 143.5 = 233.0$ Btu per lb

Step 6. Find the total time (Δt_F) required for the deaerating heater pressure to decay to the low-load condition. Equations 3, Table II, applies for this time interval and h_{xL} is known to be 173.0 Btu per lb from the data, so Δt_F is determined as follows:

$$h_x = h_{xL} = \frac{\left(h_{xD} - \frac{K_4}{K_1}\right)e^{-K_1 t}}{e^{-K_1 \Delta t_D}} + \frac{K_4}{K_1} = \frac{\left(h_{xD} - \frac{K_4}{K_1}\right)e^{-K_1 \Delta t_F}}{e^{-K_1 \Delta t_D}} + \frac{K_4}{K_1}$$

$$\text{therefore } 173 = \frac{(196.1 - 137)e^{-(2.98 \times \Delta t_F)}}{e^{-(2.98 \times 0.259)}} + 137$$

$$= \frac{(59.1)e^{-2.98 \Delta t_F}}{0.461} + 137, \text{ or, } e^{-2.98 \Delta t_F} = \frac{(173 - 137)0.461}{59.1} = 0.281$$

This expression can be solved logarithmically or with handbook tables to give $\Delta t_F = 0.425$ hr

Step 7. To provide a fairly even distribution of data for charting across the full scale of time in Fig. 2, solve equation 2 for $t = 0.150$, and equation 3 for $t = 0.350$, as follows:

A. If $t = 0.150$, $\Delta t'_D = 0.150 - \Delta t_c = 0.150 - 0.0356 = 0.1144$, therefore, equation 2 is written

$h_{xD} = (245.5 - 143.5)e^{-(2.98 \times 0.0044)} + 143.5 = 216$ Btu per lb

B. If $t = 0.350$, equation 3 is written

$$h_x = \frac{(196.1 - 137)e^{-(2.98 \times 0.350)}}{e^{-(2.98 \times 0.259)}} + 137 = 182.2 \text{ Btu per lb}$$

Step 8. Find the mean heater pressure (P_x) at each time interval. Enter the saturated steam tables with the mean heater enthalpies (h_x) for those times. Tabulate this information as shown in Table III.

Step 9. Find the heater pressure (P_s actual) at the different times by subtracting the pressure of the hydrostatic head (above the point at which the mean pressure P_x was determined) from P_x. In this case the head factor is $\frac{8}{2} = 4$ ft, or 1.6 psia. Therefore, P_s actual $= P_x - 1.6$. Values are listed in Table III and plotted against time in Fig. 2.

Step 10. Find the vapor pressure of water at the pump inlet (P_{vp}) for the different times by adding the pressure of the hydrostatic head to the values of P_x for the different times. Therefore, $P_{vp} = P_x + 1.6$. Values are listed in Table III.

Step 11. Find the temperature and density of water at the pump inlet for the different times by entering the saturated steam tables with the values of P_{vp} just obtained and finding the corresponding values. List these in Table III.

Step 12. Find the required heater pressures (P_s), corresponding to the temperatures just obtained, by applying equation 9, Table II, as follows:

A. At $t = 0$, temperature = 281 F, and from the performance curve for the pump in this example (not shown) it was found that the required NPSH for this temperature is 18 ft. Density (obtained and tabulated in Step 11) for this temperature is 57.8 lb per cu ft and P_{vp} obtained in Step 10 is 50 psia. Elevation $h_s = 40$ ft, from original data obtained from the layout drawings. Equation 8 is therefore written:

$$P_s \text{ (required)} = (18 - 40)\frac{57.8}{144} + 50 = 41.2 \text{ psia}$$

B. Repeat this procedure for $t = 0.0356$, $t = 0.079$, $t = 0.150$, $t = 0.259$, and $t = 0.350$, using data from the corresponding lines in Table III. Values of P_s (required) corresponding to these times in the left-hand column of Table III are calculated and listed. (The calculations are repetitive and are not shown here.)

Step 13. Since all values of P_s (required) are calculated on the basis of residence times at the heater, it is necessary to introduce the residence time in the suction piping (Δt_w) to make the data apply at the pump inlet. P_s (required), therefore, is plotted against $t + \Delta t_w$, which values are listed in the right-hand column of Table III.

Step 14. Two curves are now plotted on Fig. 2; one is P_s (actual) relative to time, and the other is P_s (required) relative to time. It will be noted that between $t = 0.05$ hr and $t = 0.225$ hr, the actual pressure is less than the required pressure; hence, cavitation conditions exist for that period of time.

. . . . Detect BF Pump Cavitation

Mean enthalpies of the mixed flows of drains and condensate at different values of t are represented by

$$\frac{K_2}{K_1}\ (t = 0 \text{ to } t = \Delta t_c),$$

$$\frac{K_3}{K_1}\ (t = \Delta t_c \text{ to } t = \Delta t_D), \text{ and}$$

$$\frac{K_4}{K_1}\ (t = \Delta t_D \text{ to } t = \Delta t_F).$$

Equation 4 uses the latter quantity for all values of time between $t = 0$ and $t = \Delta t_F$. This means that Equation 4 assumes that both drains and condensate lines feeding into the feedwater heater are instantly filled with waters at the low-load temperature condition when the load on the turbine drops. This admittedly is not true, but the assumption results in errors only on the safe side. If the stepwise calculation is carried out, it might be wise to repeat the calculations using Equation 4 as a check against initial accuracy.

For the case when Δt_D is less than Δt_c, the equations of Table II can still be applied provided the flows D and C and the subscripts D and c are interchanged wherever they appear. In this case, Equation 1 would apply between $t = 0$ and $t = \Delta t_D$; Equation 2 would apply between $t = \Delta t_D$ and $t = \Delta t_c$; and Equation 3 would apply between $t = \Delta t_c$ and $t = \Delta t_F$.

Table I, which lists the symbols used in these equations, also indicates the source of values for these factors. Dimensional factors can be obtained from the system layout drawings, whereas flow and condition data can normally be otained from the plant heat balance data. Vapor pressures are obtained from the saturated steam tables in any good handbook.

Net positive suction head required for the boiler feed pump under the different flow and temperature conditions is obtained from the performance curves of the pump under study, with particular attention being given to the temperature corrections. Values of NPSH used in the example in Table IV are obtained from curves not shown in this article.

Plotting Results

Values obtained for time, mean heater pressure, actual heater pressure, vapor pressure, temperature, density, required NPSH, and required heater pressure are tabulated as shown in Table III. A final column is added at the right to show the time (t) plus residence time in the suction piping (Δt_w).

With results tabulated in this manner, plot the actual heater pressure (fourth column) against corresponding values of time (first column). This is the picture of pressure decay within the heater. Next, plot the values of P_s (required) against values of time in the right-hand column. This is the picture of safe or non-cavitating heater pressure throughout the decay time, based on safe values of NPSH at the pump inlet at various times.

When the "required" pressure line falls below the "actual" pressure line, cavitation will occur. In the example plotted in Fig. 2, this occurs between $t = 0.05$ hr and $t = 0.225$ hr.

There are many possible methods to correct the design conditions that produce cavitation in the example. Though they apply in principle to all similar systems, these methods are given here as they would affect the system given in Table IV.

Corrective Measures

Increasing the storage capacity of the deaerating heater would also increase its heat storage capacity and, therefore, slow down its pressure decay. In the example, if the storage capacity were increased to 1250 cu ft, the heater pressure would be 42.8 psia after 0.079 hr. Since this pressure is greater than the required heater pressure of 41.2 psia, cavitation in the boiler feed pump would be avoided.

A second method would be to decrease the residence time of the boiler feed pump suction piping (Δt_w). The shorter this period of time, the less will be the difference in pressure between the heater pressure and the feedwater vapor pressure at the pump at any instant. This can be accomplished by a careful layout of the piping to assure the shortest run possible, and sacrificing some additional pressure drop for smaller-diameter piping. A small change in residence time would be very effective in correcting cavitating conditions. With a residence time of 0.050 hr instead of 0.079 hr, for example, the heater pressure would be 41.9 psia, which again is greater than the required 41.2 psia.

A third method, and one generally used in power plant design, is increasing the height of the deaerating heater or, conversely, lowering the pump elevation. Greater values of h_s in Equation 9 would result in lower values of P_s (required), or required heater pressure. Increasing the heater elevation, however, would increase the residence time in condensate, drain and feedwater suction piping. The increase in residence time in the condensate and drain lines is desirable, but it is undesirable for the suction piping. Assuming the piping, and thus the residence time, is increased in proportion to the increase in heater elevation, the required heater pressure in the example would be 29.1 psia for an elevation of 70 ft and a residence time (Δt_w) of 0.138 hr. The heater pressure at this same instant would be 30.1 psia, so cavitation in the pump is not likely.

Other methods to offset cavitating conditions are:

1. Injecting cold water into the boiler feed pump suction.

2. Install a heat exchanger in the suction line of the feed pump with feedwater cooled by the condensate before it enters the deaerating heater.

3. Injecting high pressure steam into the deaerating heater when the heater pressure drops below some predetermined value.

4. Install anti-flash baffling which channels water from the top of the storage tank to the pump suction rather than from the bottom of the storage tank. By this method, lower-temperature water with lower vapor pressure will be available at the pump suction and reduce the required heater pressure by the difference in hydrostatic head in the storage tank. Since the feedwater enters the pump suction line at the top of the storage tank, however, the length of the suction piping and therefore the residence time Δt_w will increase and offset to some extent the gain due to lower vapor pressure.

Methods 1 and 2 effectively reduce the value of the P_{vp} factor in Equation 9, thereby resulting in a lower required heater pressure. Method 3 prevents heater pressure decay, thereby preventing possible pump cavitation by maintaining constant heater pressure even during load changes. Method 4, during pressure decay, directs the water directly to the pump suction, reducing the vapor pressure at that point and thereby reducing required heater pressure; it also increases suction residence time with the attending disadvantages.

Effect of Evaporators

If the system includes an evaporator and it is in operation during a drop in turbine load, the pressure of the deaerating heater will decay at a slower rate. Cycles in which the evaporator is arranged to pass vapor from the shell to the deaerating heater are equivalent to systems in which the storage capacity is increased. The volume of heater water in the evaporator is additive to the stored deaerating heater water. Cycles in which the evaporator is designed with an evaporator condenser in the condensate line which enters the deaerating heater are equivalent to systems in which hotter condensate is dumped into the heater, thus their decay rate is decreased.

For design purposes, therefore, since the evaporator does not usually operate at all times, calculations should not be based on conditions with the evaporator in operation. This could lead to a design which allowed cavitation during load drops with the evaporator shut down.

Steel in the shell of the deaerating heater storage tank acts as a heat reservoir much as the stored water does. Generally the weight of the steel is a small percentage of the weight of the water, therefore its effect is negligible. It can be taken into account, however, by multiplying the weight of steel by the ratio of specific heat of steel to the specific heat of water (about 0.12) and adding the value obtained to Q_sR_s of Equations 5, 6, 7, and 8 of Table II.

Is Your Chain Drive in Good Shape?

Check this Chart for Trouble, Cause, and Cure

SYMPTOMS	POSSIBLE CAUSES	REMEDIES
Excessive Noise	Misalignment. Too little or too much slack. None or improper lubrication. Loose casing or bearings. Chain or sprockets worn.	Check alignment and correct. Adjust centers for proper chain slack. Lubricate—following instructions on pages 14 to 24 inclusive. Draw up all bolts and brace casings if necessary. Reverse* or replace if necessary.
Wear on chain side-bars and sides of teeth	Misalignment.	Remove chain and correct alignment of the sprockets and shafts.
Chain climbs sprockets	Poorly fitting sprockets. Severe overloads. Chain worn overlength.	Turn sprockets and chain* or replace if necessary. Reduce load if possible—lubricate driven machine. Replace with a new chain.
Broken pins and rollers	Chain speed too high for the pitch. Shock or suddenly applied loads.	Use chain of shorter pitch of equivalent or greater strength. Avoid shocks—easy starts give long life.
Chain clings to sprockets	Incorrect or worn sprockets. Heavy and tacky lubricants.	Turn sprockets and chain*or replace if necessary. Clean chain and sprockets and lubricate correctly.
Chain whip	Long centers or high pulsating loads. Too much slack.	Reduce centers when possible or install a chain take-up or idler sprocket.
Chain gets stiff	Misalignment. Improper lubrication. Excessive overloads. Corrosion.	Check sprocket and shaft alignment and correct. Replace damaged chain. Remove chain, clean, and relubricate. Reduce load when possible. Protect chain with case if possible . . . or clean and lubricate chain regularly.
Broken sprocket teeth	Obstruction—or foreign material in chain case.	Check chain clearances. Drain and clean chain case.
Cotters come out	Vibration and centrifugal force.	Turn chains over so heads of cotters are on inside nearest shafts.

* Reverse chain only if it does not have rollers.

Courtesy Chain Belt Company

Static Charges Might Cause Turbine Bearing Failures

WITHIN a year after the installation of a 5000 kw turbine-generator unit at a generating station, the thrust bearing failed. This led to the discovery of an unusual case of static charges in the machine.

The thrust bearing, three main bearings and a bearing on the outboard exciter connected to the main shaft by an insulated coupling were found to be pitted and etched. Driving gears of the oil pump showed the same condition. The pitting and etching on the bearings had the appearance and usual characteristics attributable to circulating currents in the bearings, except that bearing areas which did not contact the journals were also affected.

A companion turbine-generator unit of the same age and design was then examined. It was found to be pitted and etched in a similar manner.

Because of the early thrust failure and the unusual factors in the case, it was evident that special efforts should be made to uncover the source of the attack on the bearings. Accordingly a thorough study, conducted principally by the turbine manufacturer, was started.

Bearing pedestal insulation was checked and found to be in good condition. Trial and error tests of the oil for acidity, temperature conditions and cavitation due to excessive air content failed to throw any light on the cause. The possibility of currents flowing in the building structure and finding their way into the turbines through pipe lines, etc., was discounted.

An oscillograph test was used to determine whether shaft voltages to ground were present. This test revealed that voltages were not only present but would build up to between 180 and 210 volts and then fall off to zero. The cycle would then be repeated. The oscillograph showed d-c static voltage on the rotor, whereas the normal shaft current usually found on rotating fields is a-c current.

It was finally concluded, according to *The Locomotive*, that the trouble did not originate in the generator ends of the units, but in the steam turbines, because without excitation on the generator the static voltage could be built up on the rotor by rapidly accelerating the speed of the turbine when bringing it up to normal speed.

In an endeavor to arrest the attack, even though the cause had not been fully established, a grounding brush (of silver bearing material for

STATIC CHARGES . . . . .

(Continued)

good contact and longer wear) was installed at No. 2 bearing and connected to the generator end bell. This produced some improvement but the results were not entirely satisfactory.

It was learned from engineering papers that similar difficulties experienced with English installations are believed to have been caused by static charges generated in the lower stages of the steam turbines. These static charges reportedly develop only under certain conditions of load, pressure, vacuum and temperature; but build-up of charges cannot always be determined in advance or duplicated at will.

One case reported in a foreign engineering paper concerned difficulty experienced with a turbine-generator unit after it had been in service for several years. A badly worn thrust bearing was found upon inspection and was renewed. The replacement bearing lasted less than two weeks. Another new bearing was installed, but lasted no longer. Use of an oscilloscope then disclosed a continual build-up and discharge of static charges and this was corrected by grounding the turbine shaft at No. 1 bearing.

It is said that several of the leading manufacturers in Great Britain have now standardized on the use of grounding brushes connected between the turbine shaft and bed plate at the outboard end of No. 1 bearing.

Because of the successful results reported, this method of grounding the shafts was applied to the two 5000 kw units in questions. Extension stub shafts were installed at the turbine ends of the main shafts. These stub shafts were silver plated and equipped with silver-bearing brushes. All parts affected by pitting and etching were then replaced with new. Thus equipped, the units were tested in service and it was found that build-up of static charges no longer occurred.

Apparently little is known about the cause and nature of these static charges at the present time. However, grounding the shaft at No. 1 bearing seems to be a cure for the trouble.

If the presence of static charges is suspected to be the cause of bearing troubles in a turbine-generator unit and shaft currents cannot be detected with usual instruments, an investigation by use of a high resistance voltmeter, such as a Simpson Analyzer, or tests with an oscilloscope or oscillograph may disclose the presence of such charges. An investigation of this kind should be conducted over a considerable period of time before concluding that these static charges do not exist, because the charges may occur only periodically.

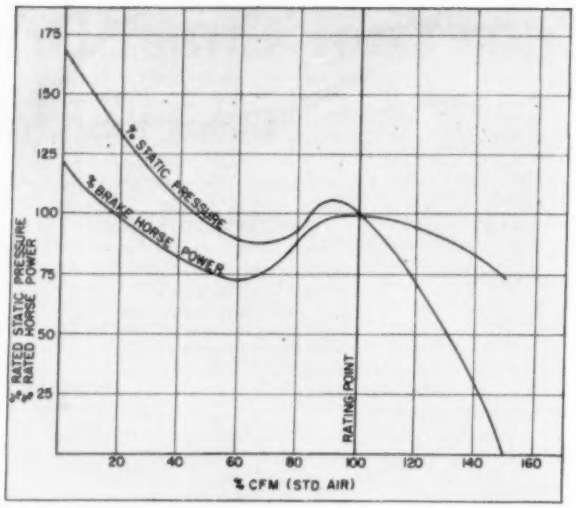


Fig. 1. Variation of horsepower and pressure with volume for vane axial fan

How Much Power Does a Fan Need?

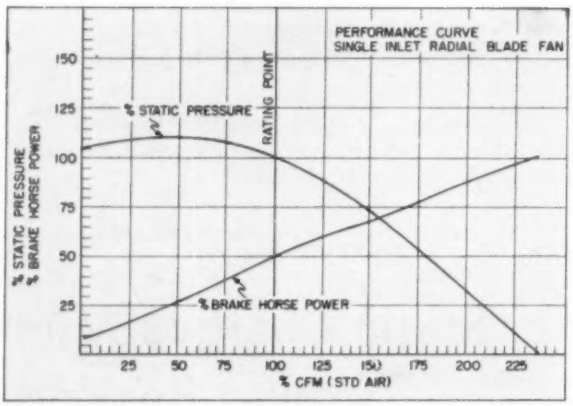


Fig. 2. Horsepower and pressure variation with volume for radial blade fan

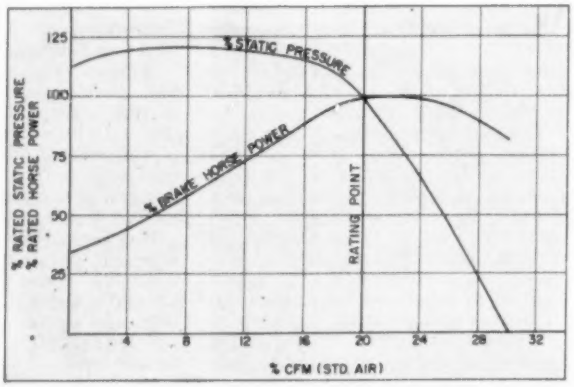


Fig. 3. Performance curves for backward blade fan, "nonoverloading-type"

Variations in operating conditions can produce startling changes in fan power required. Before choosing a fan make sure that you know what changes may occur and also how the fan will react to them

By JOHN F. TOBIN *

IN DELIVERING a certain volume of air or gas from one point to another fans do work requiring certain input horsepower. By definition of James Watt, inventor of the steam engine, some two centuries ago, a horsepower is 33,000 ft lb per min, which he determined experimentally as the capability of a good horse which his engine replaced.

This basic formula converts, for fan calculations, to $hp = \frac{cfm \times Pressure}{6356 \times Efficiency}$ where cfm is the actual volume of air or gas in cu ft handled per min, pressure is either static or total pressure in inches of water, 6356 is a constant, and efficiency is either static or mechanical depending on whether static or total pressure is used. This formula for fan horsepower is similar to the one for a hydraulic pump which is $hp = \frac{gpm \times Head \times Specific\ Gravity}{3960 \times Efficiency}$ which uses a different constant value. Because the head is measured in terms of the liquid pumped, the specific gravity value is needed. In fan work the pressure is measured in a liquid gauge reading in inches of water not in head of the air pumped, so density of air does not appear directly in the horsepower formula. If a liquid with a density other than water is used in the pressure gauge, the scale should be corrected to water for use in above fan horsepower formula.

Volume Is Actual Volume

In using this formula the volume is always the actual volume at operating conditions of density, temperature and altitude. Based on constant system and constant fan speed the density is a factor only so far as it changes the system pressure in direct proportion to density change (volume remains unchanged). Consequently, the horsepower input to fan will vary directly with air and/or gas density. Generally static pressure and static efficiency are used in the formula where the terms pressure and efficiency appear. Static efficiency values as given in the following table may be used as a guide for the various fan types:

Type of Fan	Per cent Static Efficiency	hp Curve Type
Propeller	20–40	A
Tubeaxial	30–50	A
Vaneaxial	50–65	A
Radial Blade	55–70	B
Radial Tip	55–70	B
Forward Curved	55–75	B
Backward Curved	60–80	C

The first three fan types (A) have horsepower curves similar to those in Fig. 1. Both pressure and horsepower curves rise similarly with reduced volume and drop with increased volume. These fans develop pressure as a component of blade angle and velocity. The reaction of the developed pressure tends to windmill the wheel backwards against rotation, increasing the torque and required horsepower with increase in pressure. The pressure reaction on the wheel is felt in the fan bearings. The axial thrust imposed on the fan bearings can be very great on large fans at high pressure, requiring special thrust bearings.

The second group of three fan types (B) have horspower curves similar to those in Fig. 2. In these centrifugal fans the pressure and horsepower curves are reversed. At or near point of minimum volume the pressure is maximum and horsepower minimum. At point of maximum volume the pressure is minimum and horsepower maximum.

The third fan type (C) has a horsepower curve as in Fig. 3. This resembles Fig. 2 from zero volume to the recommended operating point. From then on it drops in a manner similar to Fig. 1. This characteristic has created a layman's term of "non-overloading type fan" which incidentally has its maximum horsepower near the point of maximum efficiency.

In a previous article the effect on capacity, due to 50 per cent error in pressure specified, was shown for the three basic centrifugal fan types as described above. The effect on horsepower for the same fan selections, under similar excessive error of pressure selection, is given in tabular form below:

	Radial Blade	Forward Curved	Backward Curved
D—50 per cent over pressure			
per cent decrease in volume	14	20	13
per cent decrease in HP	14	21	6
E—50 per cent under pressure			
per cent increase in volume	30	36	18
per cent increase in HP	25	43	0

All of the basic types under condition "D" require an increase in speed and approximately 50 per cent more power if the specified air quantity must actually be delivered through a duct system which has 50 per cent more resistance than first estimated.

An excessive amount of additional capacity cannot be tolerated because only so much air is needed for combustion, air conditioning, heating, ventilating or process work. If condition "E" should exist the fan volume must be brought back as near as possible to the design value either by reducing the speed or by partially closing the inlet vanes or dampers.

The backward curved blade fan has the least variation in volume and horsepower under conditions of "D" and "E". The penalty for this characteristic, however, is a high tip speed approximately 40 per cent greater than the radial blade fan and approximately 80 per cent greater than the forward curved blade fan. High fan wheel tip speed introduces undesirable factors which should be evaluated carefully for each separate application.

Experienced fan engineers use all three basic fan types. Each has its place but must be properly considered as to its operating pressure and need of overload protection in case condition "D" or "E" develops. Proper motor controls will protect the motor and proper fan controls will prevent excessive fan volume and hp. Fans, like any other machines, must be under complete control at all times to properly perform as required under varying volume, pressure and density conditions.

Smaller Frame Sizes

Most fans today are driven by electric motors. There is a growing tendency towards the use of smaller frame sizes and totally enclosed designs having little or no overload capacity. Fans under 100 hp are commonly V-belt driven and fans requiring over 100 hp are generally direct connected. V-belt drives require approximately 5 per cent of the motor horsepower in the integral frame sizes and approximately 10 per cent in the fractional horsepower sizes. Therefore, it is well to select motors at least 5 per cent over the calculated fan power load if direct connected — plus 10 per cent if V-belt driven and over 1 hp — and plus 15 per cent over if V-belt driven with a fractional horsepower motor.

The motor must be able to start the fan and bring it up to full speed as many times an hour or day as required. This was not a problem in the old days, but the demand for larger diameter and heavier and higher speed wheels frequently imposes a heat load on the motor beyond its capability for frequent starting. Special motors are sometimes required to start large fans, however, standard motors with fluid drives are being widely used for this purpose. The combination of standard motor with fluid drive has the added advantage of stepless adjustable speed fan operation in addition to its ability to start a heavy load.

Do not let the shape of the fan horsepower curve mislead you into an improper fan type selection. Do not motor the fan too closely because unforseen density changes will affect any type of fan horsepower directly and line voltage variations will affect the motor's capacity.

*Manager, Western Division Power Equipment Manager, American Blower Corporation

Paul J. Grogan's* Graphical Solutions for Power Engineers

Figuring Combustion Air-to-Fuel Ratios

THE THEORETICAL and actual air-to-fuel ratios for various steaming fuels may be determined from the accompanying graphical construction. The only data necessary for these determinations are the chemical composition of the fuel and the excess air supplied for proper combustion. Knowing the above, this construction may be applied for any common fuel over a wide range of combustion conditions.

Theoretical Air Requirements

While fuels occur in the three forms of matter and exhibit a variety of physical and combustion properties, their compositions are really very much alike. Steaming fuels quite generally consist of combustible carbon, hydrogen, and sulfur, with varying quantities of oxygen, nitrogen, ash, and moisture. Carbon, hydrogen, and sulfur are consumed in chemical reactions resulting in the formation of carbon dioxide, water vapor, and sulfur dioxide. The incomplete combustion product, carbon monoxide, has been overlooked in this discussion. The oxygen in the fuel is assumed to have played an earlier role of combining with hydrogen to form carbohydrates. The oxygen and a certain portion of the hydrogen are therefore considered to be inert.

The theoretical air to fuel ratio for a given fuel may be determined from the following equation:

$$W_{ta} = 11.52C + 34.56(H - O/8) + 4.32S$$

where

- W_{ta} = pounds theoretical air per pound of fuel
- C = pounds of carbon per pound of fuel
- H = pounds of hydrogen per pound of fuel
- O = pounds of oxygen per pound of fuel
- S = pounds of sulfur per pound of fuel

The validity of the equation above may be checked with any standard reference. The decimal fractional composition of the fuel may be taken from any ultimate analysis. It is interesting to note that the theoretical air requirements determined from the above may be upon *any* of the common bases of reporting fuel analysis. The decimal composition of the fuel may be *dry*, *as-received*, *as-fired*, or *combustible* base. The pounds of theoretical air determined from the above will be upon the corresponding base.

Example 1: Given the following fuel composition: carbon = 0.70, hydrogen = 0.05, oxygen = 0.08, sulfur = 0.02, determine the theoretical pounds of air required per pound of fuel.

Enter the chart at 70 per cent along the carbon scale at the bottom. Follow reference line "A" to the heavy reference line corresponding to "zero per cent" sulfur, "zero per cent" hydrogen, and "zero per cent" oxygen. The pounds of air necessary for complete and perfect combustion of the carbon may be read along the left-hand scale. The portion of the equation "11.52C" has been solved. In this instance, 11.52(0.7) equals 8.06.

Return now to the intersection of line "A" and the heavy reference line. By shifting slightly to the right to 2.0 per cent sulfur and returning again to the heavy reference line, the influence of "4.32S" has been taken into account.

Next, follow line "B" horizontally to the left until the line of 8 per cent oxygen is intersected. This step has the effect of accounting for the oxygen in combination with a portion of the hydrogen in the fuel. Move up the chart along line "C" to the intersection with the line representing 5 per cent hydrogen. Follow line "D" to the left-hand scale. The problem solution is read as being slightly over 9.5 pounds of theoretical air required per pound of the given fuel.

Actual Air Requirements

There is considerable practical merit in a plan which makes it possible to determine actual air requirements in terms of known fuel characteristics. A family of lines has been included on the "Air-to-Fuel" chart which makes it possible to accomplish this objective. The relationship between theoretical and actual combustion air may be expressed by introducing an excess air quantity:

$$W_{da} = W_{ta}(1 + \overline{XS}), \text{ where}$$

- W_{da} = actual pounds of dry combustion air supplied per pound of fuel
- W_{ta} = theoretical pounds of combustion air required per pound of fuel
- XS = decimal fraction of excess air required for proper combustion.

The per cent excess air varies in practice from a few per cent to perhaps as much as 100 per cent. Both the type of fuel and the class of fuel burning apparatus have an influence upon this variable.

Example 2: What is the actual air to be supplied per pound of coal in Example 1, above, if the necessary excess air for good combustion is 50 per cent?

Begin where line "D" intersects the line of 50 per cent excess air. Proceed upward along line "E" and read the desired answer along the top scale as being 14.3 pounds actual air required per pound of fuel.

Application to Liquid Fuel

As an exercise, you should attempt to use the construction to determine the theoretical and actual air requirements for an oil containing 85 per cent carbon and 12 per cent hydrogen with no appreciable oxygen and sulfur. Assume the fuel is burned with 20 per cent excess air.

Answers of approximately 14.0 and 16.8 air-to-fuel may be checked by the equations as well as the chart.

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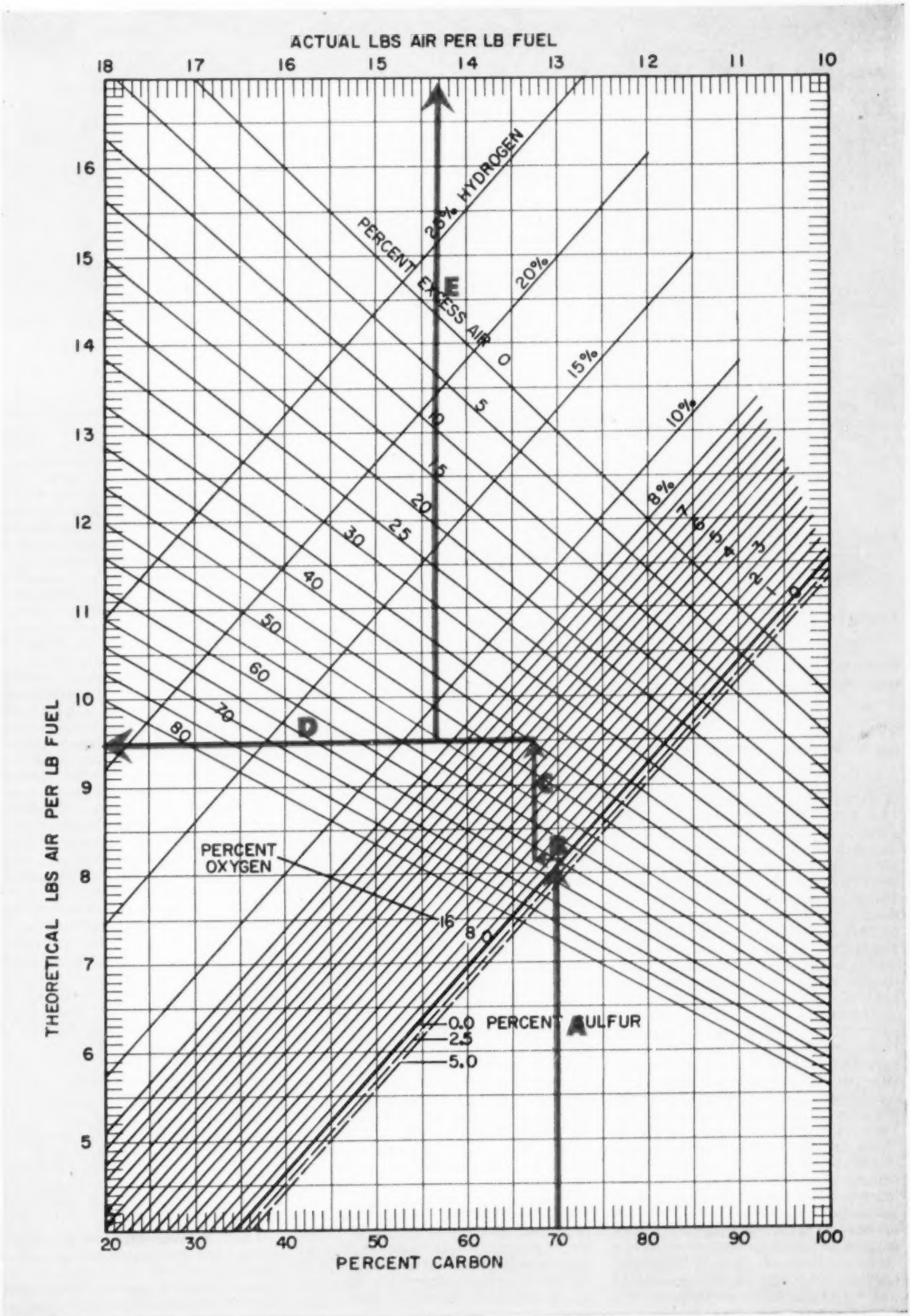
* Chairman, Department of Engineering, and Director of Engineering Institutes, University Extension Division, University of Wisconsin. All republication rights reserved by author.

NOTICE!

If you wish extra copies of Paul Grogan's "Graphical Solutions" articles, you may obtain them by writing to The Editors, POWER ENGINEERING, or by filling in its title on the prepaid card elsewhere in this issue. The series will eventually deal with most of the power engineer's problems.


ACTUAL LBS AIR PER LB FUEL
18 17 16 15 14 13 12 11 10
THEORETICAL LBS AIR PER LB FUEL
16 15 14 13 12 11 10 9 8 7 6 5
PERCENT CARBON
20 30 40 50 60 70 80 90 100
25% HYDROGEN
20%
15%
10%
8%
7
6
5
4
3
2
1
0
PERCENT EXCESS AIR
0
5
10
15
20
25
30
40
50
60
70
80
E
D
C
A
PERCENT OXYGEN
16
8
0
0.0 PERCENT SULFUR
2.5
5.0

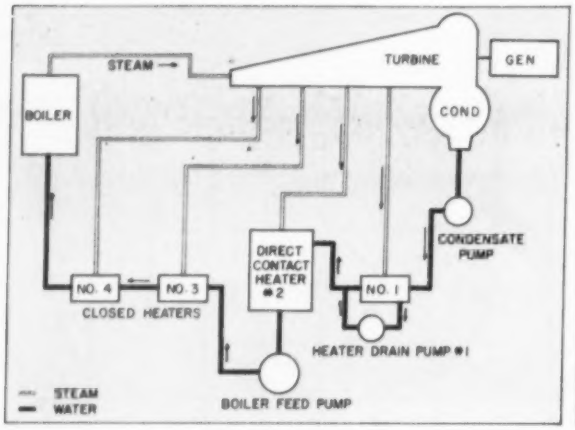


Fig. 1. Diagram to illustrate simple open cycle for boiler feedwater heating

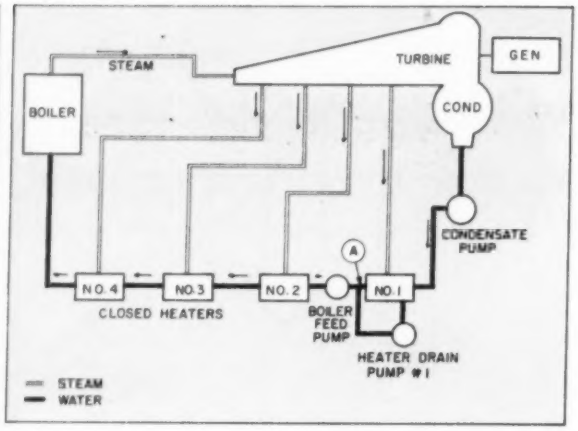


Fig. 2. Diagram showing simple closed cycle for feedwater heating system

Study Feedwater Heater Drain Pump Systems

First of two articles describing heater drain pump systems and explaining points to watch when choosing new drain pumps or checking to be sure that the ones you have are right for your system

By T. W. EDWARDS*

MODERN STEAM-ELECTRIC generating stations use a wide variety of boiler feedwater heaters. These heaters are used to pre-heat the boiler feedwater prior to its introduction into the main steam generator. Heat for their operation is usually derived from steam extracted at various pressures from intermediate stages of the main turbine. This steam is partially, if not fully, condensed in the heaters, and its latent heat of evaporation is imparted to the feedwater.

In general, there are two types of boiler feedwater heaters, i.e. the open type and the closed type. In the open type, the extracted steam mixes intimately with the feedwater, heating it, condensing, and passing out of the heater with it. In this type of heater, there are no separate drains. In a closed heater, on the other hand, the exchange of heat from the extracted steam to the boiler feedwater is accomplished through the use of a system of tubes. The heater physically resembles a condenser although certain types of closed feedwater heaters are vertical. The extracted steam and the boiler feedwater never come into direct contact; and the steam condenses merely by loss of its latent heat of evaporation and collects as liquid drains in a hot-well at the bottom of the heater. It is these drains which must be dealt with. Since they contain heat and pressure energy, they cannot be allowed to go to waste, but must be reintroduced into the feedwater cycle. Further, these drains are actually treated water which has been deaerated and which, if wasted, would have to be replaced, incurring added and unnecessary cost.

Two basic methods are available for returning these heater drains to the boiler feed cycle. Since they are at, or very close to, saturation temperature and pressure, they can be flashed into the steam space of a lower pressure heater through a trap; or they can be pumped into the feedwater system at some higher pressure point. Also, it is possible to use a cycle which combines these two methods in the various heaters. The choice between these methods usually depends upon heat balance considerations. General heater and boiler feedwater arrangements selected in the preliminary planning stage will often dictate to a large degree the method of re-introduction to be used; i.e. flashing the drains to a lower pressure heater or to the condenser (sometimes called "cascading"), or pumping them to a higher pressure point in the boiler feedwater system.

In any particular closed heater drain application, the choice between draining the heater by means of cascading to a lower pressure heater or pumping the drains to a higher pressure point in the boiler feedwater cycle is rarely clear cut. All aspects of these two methods together with the advantages and disadvantages of each must be fully investigated. Then the decision must be made based upon this individual unit investigation. In general, however, cascading does have the disadvantage of loss of heat energy which occurs in flashing to a lower pressure heater; and especially in the case of low pressure heaters, the piping required may become excessively large. However, no power is consumed. In pumping the heater drains directly into the boiler feedwater system, on the other hand, heat is conserved, pipe sizes required are more reasonable; but power is consumed.

There are two basic classifications into which all feedwater heating cycles fall:

1. The "open" cycle is one wherein there are one or more open heaters in addition to the closed heaters. At least one of these open heaters will be of the deaerating type. As well as having the function of heating the feedwater, it serves to remove dissolved air and other gasses.

2. The "closed" cycle, on the other hand, involves no open heaters. All heaters are of the closed type previously discussed. Deaeration is accomplished solely within the main condenser which is specifically designed to perform this additional function.

A simple open system is illustrated in Fig. 1 and a simple closed system

*Application Engineer, Worthington Corporation.

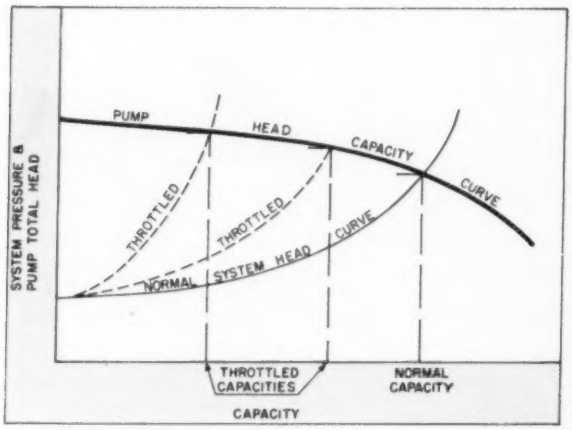


Fig. 3. Diagram showing how pump pressure increases with increase in flow

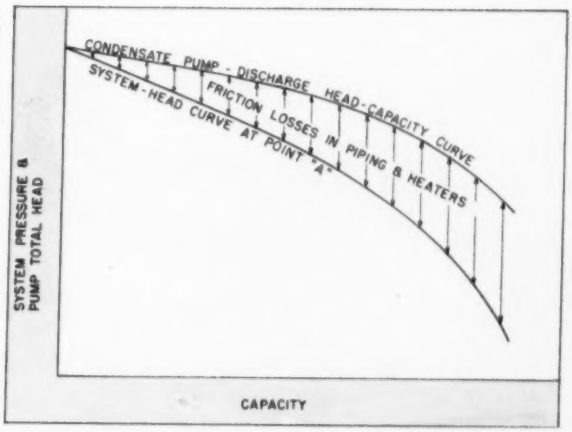

CONDENSATE PUMP - DISCHARGE HEAD-CAPACITY CURVE
SYSTEM-HEAD CURVE AT POINT "A"
FRICTION LOSSES IN PIPING & HEATERS
SYSTEM PRESSURE & PUMP TOTAL HEAD
CAPACITY

Fig. 4. Curves showing rapid rise of system pressure with decreased flow

is illustrated in Fig. 2. It should be noted here that initially we will deal only with the heaters and heater drain pumps located between the condensate pump and the main boiler feed pump. Later in the article we will mention special considerations involved in the high pressure heaters located after the main boiler feed pump. It can be seen that in an open system, boiler feed pump suction pressure is a function of the water level and pressure in the deaerating heater located just prior to it. There is storage capacity in the deaerating heater which can absorb slight variations in feedwater flow through the system. Hence, the condensate and heater drain pumps located prior to the main boiler feed pump may be individually controlled by means of throttle valves.

Thus they operate against a system characteristic which can be termed normal. Fig. 3 shows such a hydraulic system wherein the pressure against which the heater drain pump must operate increases with increased flow. The heater drain pump should be selected to produce sufficient discharge pressure to overcome this system pressure at rated station load corresponding to maximum heater drain flow. At lighter station loads, where heater drain flow is reduced, the pump capacity is often controlled by means of a discharge throttle valve. This valve produces an added friction loss in the system as shown in Fig. 3; and is usually actuated by a float in the heater hot-well, set to maintain a constant hot-well level regardless of station load. Other methods of control such as an automatic bypass in the discharge, are frequently used. Also, capacity control through limited NPSH (Net Positive Suction Head, i.e. pressure at pump suction) can be utilized where pumps specifically designated for this are used.

In a closed system, however, boiler-feed pump suction pressure is a function of condensate pump discharge pressure less friction losses through piping and intermediate closed heaters. Discharge throttle valves on the condensate pump and heater drain pumps are usually omitted, and no storage capacity is available as there was in the case of the open system. These factors produce an entirely different system pressure characteristic.

For example, let us take point A in Fig. 2. The pressure here, and therefore the pressure against which the heater drain pump must operate, is equal at any load to the discharge pressure developed by the condensate pump less friction losses prior to point A. As the station load decreases, the flow naturally decreases, and the pressure at point A will increase rapidly due to the cumulative effect of the following two factors:

1. Condensate pump discharge pressure increases with decreased flow.

2. Friction losses through heaters and piping prior to point A decrease with decreased flow.

Therefore, since the increase in pressure at point A which occurs with decreasing station load is the sum of these two factors, the system pressure curve produced at point A is very steep and increases rapidly with decreased flow, as shown in Fig. 4. Frequently this increase from normal load to minimum load will be of the order of 100 per cent.

Since the heater drain pump must be capable of overcoming this system pressure under all load conditions, its head-capacity characteristic must also be very steep, and it must be capable of producing a pressure at least equal to the system pressure at all capacities. The ideal heater drain pump in a closed system would be one having a head-capacity characteristic which would parallel and slightly exceed this system-head curve. Frequently it is not possible to attain this steepness in practice since other more necessary hydraulic characteristics must prevail, i.e. high heads per stage, low specific speeds, and reasonable pump efficiency. This steepness, which would be so desirable, would be more likely found in a centrifugal pump of relatively high specific speed and low heads per stage; in other words, in a pump which is wholly unsuitable for heater drain service. In a subsequent issue we will continue this discussion.

Air Conditioning and Voltage Unbalance

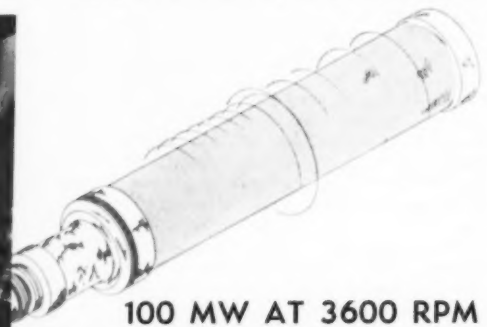
VOLTAGE unbalance aggravated by the widespread use of air conditioning — use of single phase and three-phase electrical current from a single supply, was discussed before AIEE by A. S. Anderson, Ebasco Services, and R. C. Ruete, General Electric Co.

They reviewed the problem that arises from the widespread utility practice of serving both single-phase and three-phase loads simultaneously from 120–240-v four-wire delta secondary circuits. The practice creates unbalanced load on the three-phase portions of the power system, hence customer service voltages on these systems are generally unbalanced to some degree.

"It is customary, however," they said, "for manufacturers and many utility engineers to assume that the supply voltage is balanced in magnitude and phase angle. In many cases of unsatisfactory motor operation, the utility has been blamed for unbalanced voltage where other deviations from rated conditions frequently not under control of the utility also existed. Large utility investments in transformer capacity have been made in innumerable such instances where the cost of other corrective measures would have resulted in lesser costs and more satisfactory installations. Acceptance of some degree of voltage unbalance as a fair allocated apportionment of the service factor resulting in a reasonable approach to a minimum overall cost for all concerned should be the aim of a representative national group."

40 TONS AT 500 MPH

100 mw turbo-generator at 3600 rpm has same kinetic energy as a 40-ton aircraft at 500 mph. At this speed a faulty overspeed device means disaster. Here's how one large power company makes sure its overspeed protection equipment is always in perfect order



100 MW AT 3600 RPM

They thought this turbine unit had

Overspeed Protection

Are You Sure of Yours?

TWO independent means of positively preventing turbine overspeed must be available at all times. If either the main speed governor or the overspeed trip are ineffective in preventing overspeed, the turbine must not be operated until tne trouble is corrected. *Both* must always be kept in ideal condition, and this applies, of course, to *both* sets of valves (stop and inlet) they actuate. Overspeed can be so destructive that never ought one mechanism be trusted to avoid it.

Any irregularities in the main speed governor, safety governor, relay oil system, or the throttle, inlet, intercept or dump valves, must not be allowed to continue. Experience proves that a combination of unusual circumstances may occur that will permit destructive overspeed. *Two* independent governors, both in perfect condition, and *two* independent sets of valves, also in perfect condition, are the minimum requirements.

Principles in testing the overspeed governor are as follows:

1. Frequency: often enough to insure proper functioning at all times. Some manuals urge once-monthly checking. This monthly checking ought be done in the case of all units equipped with oil or weight-tripping devices. At least twice-annual actual overspeed testing should be done, as should checking after any work has been done on any of the governor parts, or the turbine has been overhauled. The trip mechanism should be used for every shutdown and valve closures confirmed.

2. Previous inspection of governor parts: all parts should be known to be in good condition.

3. Previous trial of valves: the stop valve should be tripped shut twice from its wide-open position to

insure that it will function properly when the test is run. The inlet and reheat valves should be observed to work freely.

4. Reliable speed measurement: two, and preferably three reliable speed measurements should be taken or observed. Each observer must be able to communicate promptly with the engineer at the governor.

5. SLOWLY increase the speed above the normal, NEVER exceeding the established tripping speed, (usually 10% above normal speed) whether the trip functions or not. Learn cause of any irregularities, however slight, and report.

6. Insure that all valves (stop, all inlet, intercepting and dump valves) close rapidly and completely upon tripping. Time, with a stop watch, from tripping to complete closure of throttle valve. All valves should have accurate and reliable indicators showing open and closed positions, and should close completely within one second.

7. Inlet valve leakage: since this can overspeed turbines, ability of the unit to hold its normal speed at no-load when other conditions favor overspeeding should be tested monthly or at least upon every outage when stopping. With no load, full steam pressure and full vacuum (all conditions same as loss of field current when under load) insure that the regulating valves, alone, can hold speed from exceeding normal rpm, with the stop valve adequately open to give normal boiler pressure on the inlet valves.

Omission of generator fans, hydrogen cooling, and improvement of glands, bearings, and oil pumps have reduced rolling resistance to extremely small values. Very small openings in inlet valves offer adequate leakage area for high pressure steam to slowly overspeed modern units.

8. Record tripping speed, whether all parts functioned normally, and names of engineers present during test. The engineer in charge, or his first assistant, ought be present at every overspeed test as should a representative of the insurance company if the unit is insured. The switchboard operator should be previously informed of the test, and should be asked to read the maximum indicated cycles. Make report on form to main office, and record same data and information in the log. Report anything in question, however slight, and every irregularity.

Station

TURBINE OVERSPEED TESTING REPORT

Turbine No. ..... Date ..... Day .....

Occasion for test: (Circle right answers)

Work done on governor system? Yes No Turbine overhaul? Yes No
Work done on safety governor? Yes No Twice-annual Test? Yes No

Inspection: Before Test (Check if done)

Governor system ..... Regulating valves work freely .....
Throttle and inlet valves ..... Power piston works freely .....
Throttle valve tripped shut all right .....

Valves closed completely and within about 1 second (check)

Throttle ....., Inlet ....., Intercepting ..... Dump .....

Inlet Valves Leakage:

Speed or load when closed ..... rpm. ..... K.W. Throttle Press., ... psi
With field ..... ON ..... OFF Exhaust Press., ... "Hg.

Governor Speed Range: Minimum ..... rpm; Maximum ..... rpm

Tachometer Readings, First Trial:

Board (electrical) ..... Test (exciter end) .....
Turbine (mechanical) ..... Recorder .....
Switch-board (electrical) .....

Tripping Speed:	R.P.M.*	% Overspeed	Re-set rpm
Previous Test, Date			
Present Test, First trial			
Present Test, Second trial			

Throttle Valve Closing Time ..... seconds, by stop watch.

Any irregularities? .....

Remarks: .....

Inspectors and Other Supervisors Present: .....

(Signed) Turbine Operator ..... Plant Watch Engr. .....
Leading Operator ..... Asst. Engineer .....
Engr. in Charge .....

* If test tachometer reading is not basis for reported rpm's, explain under "Remarks."

Fig. 1. Test report such as this ensures that no step of the testing and checking procedure is overlooked

Discussion

Frequency — Once-per-shift closing of each stop valve is perhaps the major insurance against overspeed. The stop valve is the last line of defense, and due to its normal inactivity it requires most frequent attention. *It must never stick.*

Periodic operation of inlet valves not normally in use is another desirable safety precaution. Should the generator switch open at full load, for instance, all inlet valves must close in a fractional-second to prevent overspeed. If one fails to close, steam trapped past the stop valve can send the unit appreciably above the normal trip-out speed. Frequency of deliberate operation of such overload valves ought be established, based upon needs actually experienced, and then executed and a record kept.

There must be no exception to testing after work on any of the governor parts, or after general turbine overhaul.

Previous Inspection — The test ought be considered simply a confirmation of previous meticulous inspection.

Reliable Speed Measurement — Understandings ought be reached to insure that maximum allowable speed is never exceeded. Each speed observer should be able to communicate readily and reliably with the engineer at the governor, and should indicate when his instrument shows the maximum allowable speed. The tachometers should be reliable ones, checked reasonably soon before the trial. Every mounted tachometer should have the maximum safe speed (110% of normal speed) indicated and labelled, "Never Exceed."

Slow Speed Increase — Many minutes at 10% overspeed is much less destructive than one second at 20% overspeed. Experience shows that rapid speed increase is likely to result in serious overspeeding if the overspeed governing does not function, for there is not time for the observers to communicate. No unit ought ever "coast" to higher speed after tripping on test. Ever so slight "coasting" ought be reported, investigated, and corrected.

Records — In case of subsequent trouble, complete records of thorough

testing are invaluable. They prove that the engineer has fulfilled his responsibility in this regard. A copy in the main office files, received shortly after the test, adds authenticity to the plant records.

Governor Settings — Non-central setting can cause a governor to become helpless to prevent overspeed. On all turbines, the range of control ought be 95% to 105% of normal speed. *Variations can be serious.*

Check all units, when new or after overhaul, for:

A: No-load position at rated speed. The governor stem should be at approximately mid-position, and it should change in position simply with speed, not load. Provide indicator to show travel limits and normal mid-position.

B: Governor Cam: Mechanisms should be properly assembled and should not bind when operated throughout their travel. Check before operating.

C: Speed-change Apparatus: This should be permanently set to permit no more than 95% to 105% of normal speed. To reach tripping speed, governor levers should be carefully moved by hand to cause slow speed increase.

D: Valve Gear Mechanism: Inlet valves should close when a ¼" margin of power-piston travel remains, to insure their positive closure under all circumstances. Provide an indicating scale showing power-piston travel limits.

Manual Tripping — The operating and safety governors must, when operating under load, get all the valves closed in about ½ second to limit overspeeding to 10%. Obviously manual tripping cannot be relied on to prevent overspeeding if load is suddenly dropped or testing is wrong. A man cannot sense, analyze, and act in one sec.

Stop Valve and Inlet-Valve By-passes — Any pipe that circumvents these two lines of defense is obviously a serious overspeed hazard. "Warming-up" lines, reheat circulating lines, bleeder lines and drains have been known to constitute this hazard. Obviously, they must be sealed shut or plainly labelled overspeed hazard if necessary when the turbine is not at speed.

Emergency Stoppage Upon Overspeed — If valve leakage or valve by-passes cause slow overspeeding, immediate full *use of vacuum breaker* and immediate *header valve closure* may be necessary in emergencies.

Packing of Turbine Control Valves — After-valve-packing is a critical time for overspeed safety.

A turbine must never be operated, under any circumstances, with sticking valves. Better drop its load than take the chance of complete destruction of a unit.

Every individual valve must at all times close easily, for impairment of another valve in series with it for any one of many reasons may focus the entire, final responsibility of preventing overspeed upon one particular valve, and it can fail.

Packing Procedure — All old rings are removed and the gland is carefully cleaned. Each new ring is compressed, as installed, with a special sleeve if the gland is not long enough. Successively less compression is used as more rings are installed. Work the valve, if practical, after each ring is installed.

The gland is pulled down quite tight and then loosened to finger tightness.

Insure that never does the loose end of a strand foul the gland and cock or bind it.

Tighten gland nuts more if leakage is excessive, but never expect to stop all steam leakage immediately. Tighten them evenly, and then try action under service conditions. Careful follow-up is often as important as care in packing.

Valve Testing — Always, when valves are repacked, ought they be tested early before starting to insure positively free working.

With ¼ to ½ normal relay oil pressure, inlet and intercepting valves should open and close readily. They can, and should, be so tested as soon as this oil pressure can be applied after repacking. Many newer turbines are equipped with gages to show the oil pressure required to operate inlet and reheat valves.

The stop valve and reheater-outlet intercepting valve should be tested by hand opening and closing after repacking to insure normal effort to pen and close. And, of course they should be tripped shut after repacking. They should close completely in about ½ second after tripping, without steam pressure to assist their closing.

During operation they should be closed to about ½ normal opening (or about 5% pressure drop), every shift, to confirm that they close easily. As in all cases of irregularities, abnormal or questionable operation should be reported in writing as soon possible.

Operating Observations — If turbine load changes are ever "jumpy" (as if valves are sticking), investigate, report and, if a possible cause of overspeeding, stop the unit until the trouble is corrected.

Check frequently to insure normal valve openings. Have closed and opened positions marked legibly, permanently, and accurately, on every valve so there will never be any question of valve openings.

Check valve actions and positions especially well after overhaul, for wrong assembly is possible.

"You'll find the chief to be the same as any other first-class engineer—you'll have to learn to put up with him the same as we did."

Fig. 1. (left) l to r. A. W. Kramer, Editor, POWER ENGINEERING, P. R. Duffey, Chief Engineer, Youngstown Sheet & Tube Co. V. J. Calise, Director of Research, Grover Water Conditioning Co. and H. R. Fosnit, of the same firm. Fig. 2 (center) l to r. L. Skog Jr., Sargent and Lundy, J. D. Cunningham, President, Republic Flow Meters Co. Joseph Harrington, Advisory Engineer, Southern Coal Co. 1st World War Natl. Fuel Administrator. A. W. Kramer, Editor P. E. Fig. 3 (Right) r to l. W. A. Oweiss, Edward Valves Inc. explains details of valve truck to POWER ENGINEERING Associate Editors Bob Mitchell and Norman Jones

American Power Conference Honors Light's Diamond Jubilee

SEVENTY-FIVE years ago, Thomas Alva Edison invented the electric light, thus laying the foundation of the present power industry and revolutionizing our modern way of life. The American Power Conference, in its 16th annual meeting at the Sherman Hotel, Chicago, commemorated this anniversary with a special Diamond Jubilee Dinner on March 24.

Two exhibits at the dinner emphasized the development of lighting technique in the last 75 years. One exhibit was a model of the first tiny lamp made by Edison; the other was a giant 75 kw incandescent lamp made specially by General Electric for the Diamond Jubilee celebrations all over the country. This lamp was used a few weeks ago to illuminate Rockefeller Center in New York, but at the Jubilee Dinner it was kept disconnected. As the chairman, Lenox R. Lohr, president, Museum of Science and Industry, and general chairman, Lights Diamond Jubilee Celebration of American Power Conference, pointed out, if lighted in the ballroom it would scorch the walls and blind all the guests.

At dinner the chairman read a special message from President Eisenhower, who expressed his regret at being unable to attend the celebrations. The President in his message emphasized the vital part played by the power industry in maintaining our industrial prosperity, and expressed confidence in the future of the industry and the country's economy.

At the opening session, The Reverend Kenneth Hildebrand, D.D., minister of The Central Church of Chicago, delivered the invocation; the Opening Remarks were presented by Lenox R. Lohr. Then followed a paper by J. E. Hobson, director, Stanford Research Institute, Stanford, Calif., and William A. Lewis, dean of the Graduate School, Illinois Institute of Technology, which was delivered by Dr. Hobson. In this paper the authors took the power industry to task for neglecting basic research. They claimed that the technological health of the power industry has been allowed to lag dangerously, and for too many years has been too dependent upon the research of a few electrical manufacturers. This, they said, has allowed the electric power industry to be placed in a vulnerable situation in the face of aggressive competition from other energy sources, present and potential.

During the three days of the conference, papers presented covered the entire range of the power engineering field. Trend of the times was shown by the time allotted to different subjects. Not long ago atomic energy and gas turbines used to be sandwiched into sessions on other engineering subjects; now each has its own complete session.

The National Association of Power Engineers held its 52nd National Power Show at the Sherman Hotel concurrently with the 16th annual American Power Conference.

Fig. 4. View of Speakers' table at the March 24 luncheon. l to r. Lewis K. Sillcox, President A.S.M.E. Walter H. Sammis, President, Ohio Edison Company and Edison Electric Institute. M. F. Obert, Chairman, Chicago Section, A.S.M.E. Seated at right in front of table R. A. Budenholzer, Conference Director

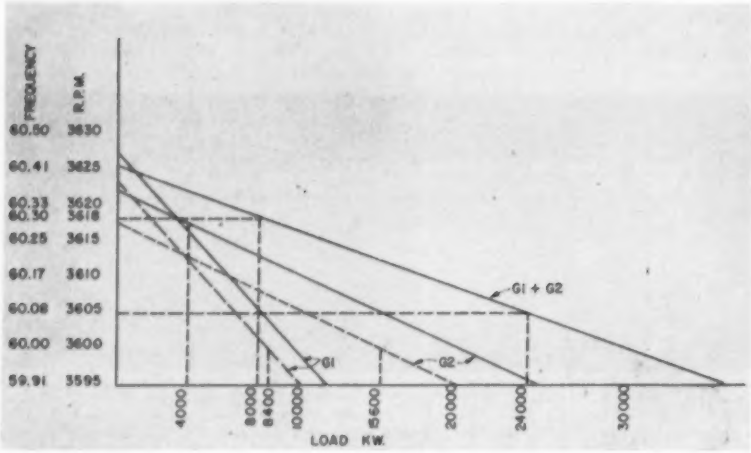


Fig. 1. Speed load characteristics of two generators in parallel. Since speeds of the two machines must be equal at all times, for each speed load sharing is determined by characteristics of each machine

More on Parallel Operation of A-C Generators

By H. A. DE BONNEVAL

IN OUR April issue we reviewed the salient electrical characteristics essential to operate generators in parallel, but as we have previously stated, the load-carrying capacity of a generator can only be affected by changing the prime mover directly, and for further emphasis it is reviewed that the governor determines the kw output; the control of the field excitation determines the reactive kva which the machine will deliver to the load or the amount of circulating current between the synchronous machines on the system.

The first effect on the generator due to an increase in load is a slowing down of the rpm, and consequently a change in frequency. This change in speed will affect the governor which in turn will alter the steam flow, and thus adjust the load carrying capacity of the generator.

Let us consider two generators of similar voltage and frequency and with similar efficiencies. One, Gen 1, 10,000 kw; the other, Gen 2, 20,000 kw, with a speed regulation of 0.8 per cent and 0.6 per cent respectively. Assuming a straight-line speed regulation at all loads, we can plot the governor characteristics (Fig. 1) of load against speed rpm or the electrical speed-frequency. With similar characteristics, if the machines had parallel governor regulation, the load would divide proportionately to their respective capacities.

With an 8000 kw load, the governors will adjust to 60.30 cycles and each generator will carry 4000 kw. At 24,000 kw total, the frequency will adjust to 60.08 cycles and the load will divide Gen 1, 8,400 kw and Gen 2, 15,600 kw. To adjust the frequency to 60 cycles, the load characteristics of each governor will have to be adjusted for the generators to operate at the required load. The no-load speed of Gen 1 is now 60.40 cycles and of Gen 2, 60.30 cycles, but it should be emphasized here that the load is carried at 60 cycles. It was previously mentioned in the analysis of the load division between two generators as shown in Fig. 1 that the efficiency of generators was practically parallel. In fact this is an exception in practice, and loads should be divided in proportion to the most economical operation of the prime movers. Moreover, when whole systems operate in parallel, the bus impedance, that is, the tie line capacity and characteristics have to be considered. Basically, the fundamentals of parallel generator operation as graphically represented in Fig. 2 remain the same.

Parallel operation of different stations (Fig. 2, Station A, B, C) was brought about not only to meet the increase in loads but to benefit from certain operating economy. It is obvious that if a load increases on one station at different times than another station, an interchange of power can take place without an increase in generator capacity. If a steam station is connected with a hydraulic plant, certain seasonal loads can be more economically handled, depending on stream flow and storage capacity. Also an efficient station can be operated at base load, and older and less efficient ones can be used to meet certain peak load requirements.

Paralleling generator stations at long distances from each other poses certain practical problems quite different than when only generators under one roof are paralleled and controlled by an operator within easy reach of all control devices.

The manual regulations of the various stations posed very obvious difficulties. The next attempt was to establish a centralized load despatcher, but this method did not solve all the problems for the maximum operating efficiency of an extended system. It has been previously noted that when load change

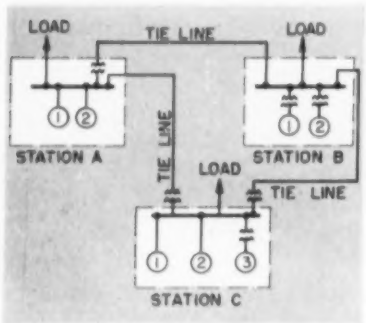


Fig. 2. Single line diagram showing simple tie line interconnection for stations operating in parallel

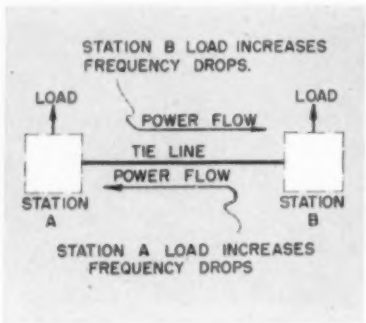


Fig. 3. Flat frequency control. Direction of power flow will depend on load taken by each station

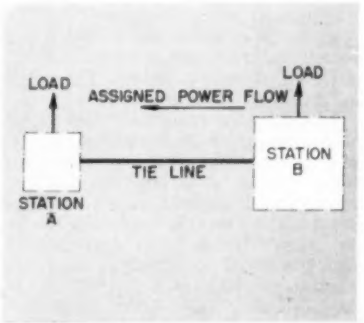


Fig. 4. Flat tie line control is employed when one station is considerably smaller than another

occurs, the frequency varies. Up to a certain time, power companies were not too mindful of small drift in frequency. But with today's increased demand for closer process control, the use of synchronous electric time motors, and the importance of maintaining tie-line synchronizing currents at a minimum, it becomes evident that maintaining an average of 60 cycles as a constant base is important.

The only physical change that a governor can see is speed change. Most commercial governors today operate within an over-all sensitivity — including linkage, servo-motor, etc., of 0.05 per cent. On a 60 cycle system this represents a 0.03 cycle change. Governors of greater sensitivity can be designed, but at a risk of losing stability; or it could be so stable as to be too slow to respond to speed change. Besides, a degree of sensitivity in excess of 0.03 cycles would serve no purpose as the inherent inertia (WR^2) of large power systems has a frequency band of approximately 0.06 to 0.10 cycles.

A paradoxical situation exists in the design of a governor, in which close frequency control is desirable, and a drooping characteristic, as previously explained, is essential to assure system stability. These two opposing functions will have to be fulfilled by two different pieces of auxiliary equipment. Operating experience has indicated that it is advantageous to have the governor designed to give best distribution of load with parallel operation stability and that some other auxiliary equipment must be used to obtain a constant base frequency, and planned load distribution.

System operation may be automatically controlled by the following methods:

1: **Flat Frequency Control** — When the load on station A (Fig. 3) increases, the frequency of that station drops. A current then flows from station B to A until both stations share the load at a lower frequency. Any variation in load between stations A and B will cause a current to flow toward the station carrying the increase in load. A frequency regulating device must then be inserted in each station to compensate for speed level change in the area in which a load change has occurred, and restore the system to 60 cycles. Should a frequency controller be located at station B only, this station would absorb the change of the system, regardless of the location of the load. The frequency is regulated through a frequency controller which sends correcting impulses to the governor motor on the prime mover.

2: **Flat Tie Line Load Control** — This type of control is employed when one station is considerably smaller than the other, and it is desired to carry a definite selected load on the tie line. The larger system is assigned to maintain the frequency (Fig. 4). Assuming that station A is the smaller of the two stations, a definite load has been assigned to flow over the tie line from station B to A. With a tie line load rigidly maintained it forces the station to absorb the whole load change where the load originates.

Accordingly, the flat tie line control is not desirable between two large systems, as it defeats the main objective of sharing the load.

A tie line load recorder controller measures the power transfer, and regulates the master load frequency controller.

3: **Tie Line Bus Control** — This is a combination of the frequency controller and the flat tie line regulator, to gain the advantage of both of these systems without their inherent limitations. This type of regulator is now in general use. It may be determined, on any section of a system, by experiment what the ratio of the change of frequency is in terms of load change. If breaker X in Fig. 5 is opened when the tie line is carrying 2 mw and the frequency drops at station A by 0.1 cycle, the regulating characteristic of station A is stated as 2 mw/0.1. Thus on a system of that regulating ratio, for each change of frequency 0.1 cycles, there is a change of 2 mw load.

Flat frequency control line aa on Fig. 6 represents the maintenance of constant frequency regardless of the tie line load.

Flat tie line load control bb on Fig. 6 represents a flat tie line load regardless of the frequency. The line cc on Fig. 6 is based on the regulating ratio of mw/0.1 assuming the schedule interchange is a point 0 at 60 cycles.

Should the system frequency drop to point X the projection X^1 shows the amount of power that would flow out at the tie point. This power will flow as long as the frequency remains at X. If the line cc, called the line load bias control, is the same as the system regulating characteristic, it will require no change in the generated output of the system.

Then, in order to maintain the system at 60 cycles, the line cc is moved parallel to itself to position dd to correct the frequency.

If all load centers were operated on their particular load frequency ratio, there would be no need for master frequency control stations and the load would be shared in proportion to their rating of generation unit groups. Tests have indicated that the regulating characteristic of generating groups, expressed in mw/0.1 cycles, is approximately 1 per cent of connected spinning capacity.

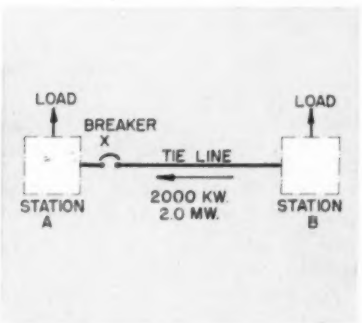


Fig. 5. Combination of frequency control and flat tie line regulator to obtain advantages of both

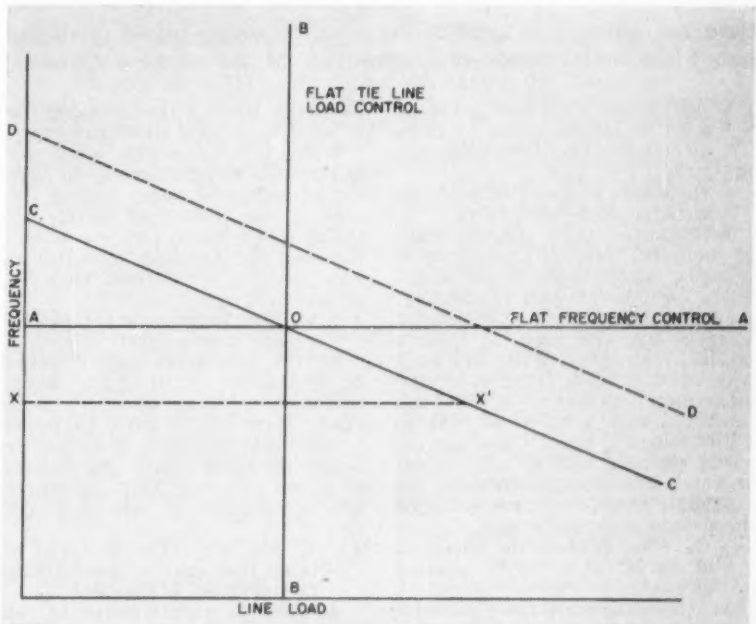


Fig. 6. Diagram showing how flat frequency control maintains constant frequency regardless of tie line load, and flat load control maintains constant tie line load regardless of the frequency in the system

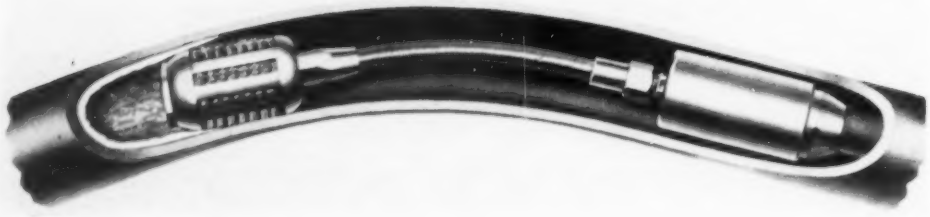


Fig. 1. View of curved tube showing action of expanding brush cleaner. Note flexible head connection

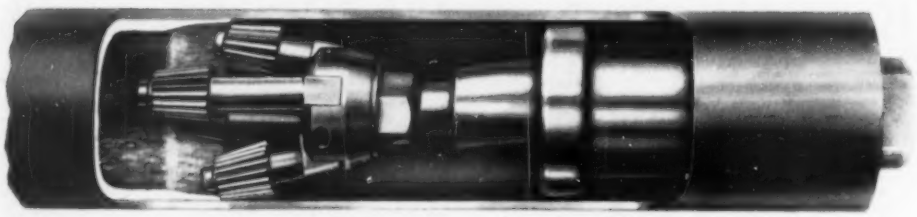


Fig. 2. Boiler tube showing pivot arm cutter head in use. Compressed air blows out debris ahead of cutter

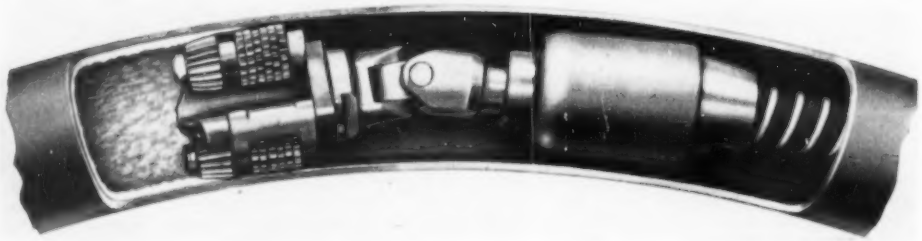


Fig. 3. Section of a boiler tube showing how the pivot joint allows free turn of cutter head in curved tube

Use Your Boiler Tube Cleaners Properly

Here are answers to some of the most frequently-asked questions about the maintenance and operation of boiler tube cleaners

By A. JOHN*

QUESTIONS given here are those most frequently asked by users of mechanical tube cleaning equipment.

1 — Q. What cleaners should be used for steel boiler tubes?

A. Standard tube cleaners may be used, but for hard scale or thick deposits, cutter heads would be selected for the first pass of cleaning. As a final pass, expanding brushes or scrapers may be used to remove residual high spots. With very hard scale or very thick deposits, it may be necessary to first use a drill head combined with a universal joint as a first cleaning pass. Where the deposits are soft, such as light oxides or water treatment compounds, the expanding scraper or brush would be the accessory normally used.

2 — Q. What governs the choice of of an air or a water operated cleaner?

A. Air cleaners are more powerful than any other type, and do a job more thoroughly and rapidly. The loosened and removed deposit is blown out through the far end of the tube by the exhaust air of the motors.

Water driven cleaners, while not as powerful as air cleaners, do have the advantage of water flushing the tube at the same time cleaning is taking place. Water cleaners require considerable quantities of water at high pressure, which could be a disadvantage in some plants.

3 — Q. How much scale can you let a boiler accumulate?

A. The theoretical answer would be no scale at all, of course, which would be rather impractical in most cases. However, it must be borne in mind that 1/16th in. of hard scale causes an approximate loss of heat of 12 per cent and ⅛ in. causes an approximate loss of heat of 20 per cent.

4 — Q. Are there certain types of tubes that can be cleaned only mechanically or chemically?

A. Restrictions are placed on the use of mechanical tube cleaners by very sharply bent tubes, such as may be found in some superheater tubes. In fact, today's large generating plants have continuous loop or pendant-type superheater tubes which cannot be cleaned mechanically, hence chemical cleaning is the only solution for such tubes. However, it must be borne in mind that it is a very rare occurrence when a superheater tube becomes scaled.

Tubes, such as long water-wall types with many bends, the total of which exceeds 270 deg, are not practical to clean unless available from both ends. The number of bends in the total degree of curvature, although allowing the cleaner to pass through, would probably prevent it being extracted.

5 — Q. Can cutter heads be sharpened if there is no time to wait for new ones?

A. If the cutters are of the drill head and universal joint type having three, four, or five flutes, they can be readily ground by hand and maintained in a sharp condition. On the

* Thomas C. Wilson, Inc.

other hand, if the cutter head is the kind that uses a series of fine toothed cutter wheels, then it is not very practical to sharpen these cutter wheels. However, in an emergency it is possible to touch them up to give a slight improvement in operation.

6 — Q. What precautions about clothing should be observed while tube cleaning?

A. Wear close-fitting clothes and keep sleeves down when using tube cleaners. Respirators should be used when dust is prevalent. Face-fitting goggles will protect eyes from scale, steel and dirt.

7 — Q. What precautions should you observe when inspecting tubes?

A. Never inspect a tube from the opposite end until the tube cleaner has been removed and the safety plug stuck into the tube.

8 — Q. Should the motor be stopped before or after cleaner is withdrawn from the tube?

A. Before.

9 — Q. What are the most usual operating pressures for tube cleaners?

A. Air motors are generally designed for operation at 80 to 125 psi but when they are operated on steam 90 psi is the generally accepted pressure. Water driven cleaners usually operate most successfully at pressures from 130 to 150 psi.

10 — Q. Should the motor be started before or after the cleaner is inside the tube?

A. Always *after* the cutter head and cleaner are inside the tube.

11 — Q. What is a good method of using self-feeding cutter heads?

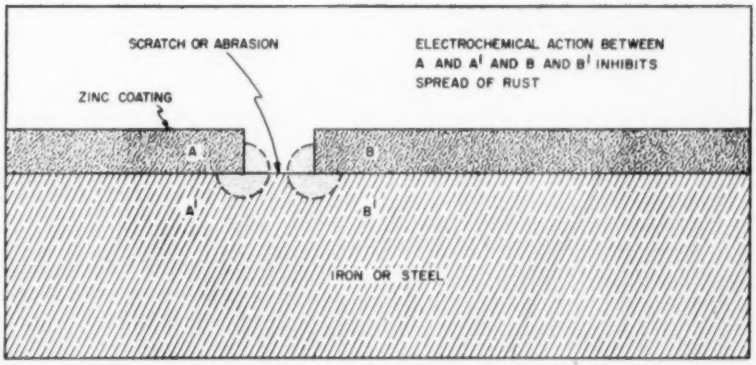
A. When using self-feeding cutter heads let the cleaner feed slowly and evenly, and if necessary hold back slightly on the hose so it will not jump over hard patches of scale. If pieces of scale have still been left in the tube, allow the cleaner to run through the tube at a fairly rapid rate while sighting through the tube.

12 — Q. What are the disadvantages of using a pumping motion for cleaning?

A. Using a back-and-forth motion for cleaning brings the cutter head into contact with the metal of the tube for approximately one half the time cleaning is taking place. This leads to tube abrasion and rapid wear on the cutters. Feeding the cleaner into the tube too rapidly has resulted, in some cases, in the cleaner getting locked in the tube.

13 — Q. How far into the tube should the cleaner be allowed to extend?

A. Never allow the cleaner to protrude from the end of the tube when under power. Most damage to equipment occurs when the cleaner is allowed to run out of the end of the tube. When the end of the tube is reached, its position can be marked by taping the hose or applying some sort of clamp to give a stop position.



Electrochemical action of zinc-rich coating prevents corrosion even beyond area covered by coating

New Zinc-Rich Paint Gives Real Rust Protection

Electrochemical action enables this new coating to give metals same protection as galvanizing

NEW LIQUID plastic paint containing as much as 93–95 per cent metallic zinc is claimed by its manufacturer to give the same kind of protection as hot dip galvanizing, electroplating, or tumbling. The paint, which is applied by brush or spray, amounts to a "cold galvanizing" process, since it depends for its action on electrochemical action in the same way that hot galvanizing does. Metallic zinc, when exposed to corrosive atmosphere, becomes anodic; the entire steel area covered by the zinc becomes cathodic. Now corrosion attacks at the anode, or zinc layer, leaving the steel untouched. When the zinc is attacked it breaks down into a firmly adherent film of zinc hydroxide (or calcium carbonate in salt water) and this film in turn offers additional anti-rust protection, both to the zinc and the steel and slows down additional breakdown of the zinc.

These new paints consist of liquid plastic containing a high concentration of metallic zinc. They are known as Zinc Rich Coatings, or ZRC.

In checking further rusting this paint prevents creeping or sideways spreading of rust beneath the protective coating. An additional advantage of this metallic zinc paint is that it can be applied directly over rusted surfaces, and it will check further the rust spread as well as reduce the amount of rust present at the time of application.

Because of its anti-rust action, it will serve to check rust even if improperly applied. Its action is such that it will halt rusting even beyond the edges of the protective film.

When applying over rust, mill scale and old paint, all that is necessary is to remove loose rust, scale and paint with a wire brush before applying the ZRC.

Brushing is the best way to apply the paint, but it can be sprayed. It dries to a flat gray finish, and is touch dry in 30 minutes, hard in four hours.

In addition to the characteristics already described, these new Zinc Rich Coatings have several other new and unusual qualities.

1. The plastic vehicle has a tougher film with greater adhesion than chlorinated rubber or styrene vehicles.
2. Problem of holding the heavy zinc pigments in solution has been solved with a new anti-settling and film-reinforcing agent that eliminates hard settling in storage and constant stirring during application.
3. These coatings can be thinned with regular paint thinners; no special solvents are needed.
4. Added chemical materials increase the electrical conductivity of the basic resin, giving higher efficiency of electrochemical reaction.
5. When dry these coatings can be buffed to a bright coat to match surrounding surfaces when used for patching galvanized vessels.

Range of application of these coatings is practically unlimited. They can be used for structural steelwork, bridges, metal window frames, steel staircases, corrugated iron roofing, gutters and downpipes, water tanks, shipbuilding, dock and harbor installations, railway installations, gasoline and gas storage tanks, automobile and truck maintenance, and agricultural equipment.

For more information about this remarkable new product write to the Editor, or use one of the prepaid post cards you will find elsewhere in this issue. Just write ZRC on the card and mail it to us

Steam Generating Station Manpower Operating Costs

Remarkable things have been done with thermal efficiencies in recent years and station performances are rapidly nearing the maximum. Manpower utilization, however, is ripe for improvement; and management decisions show the way

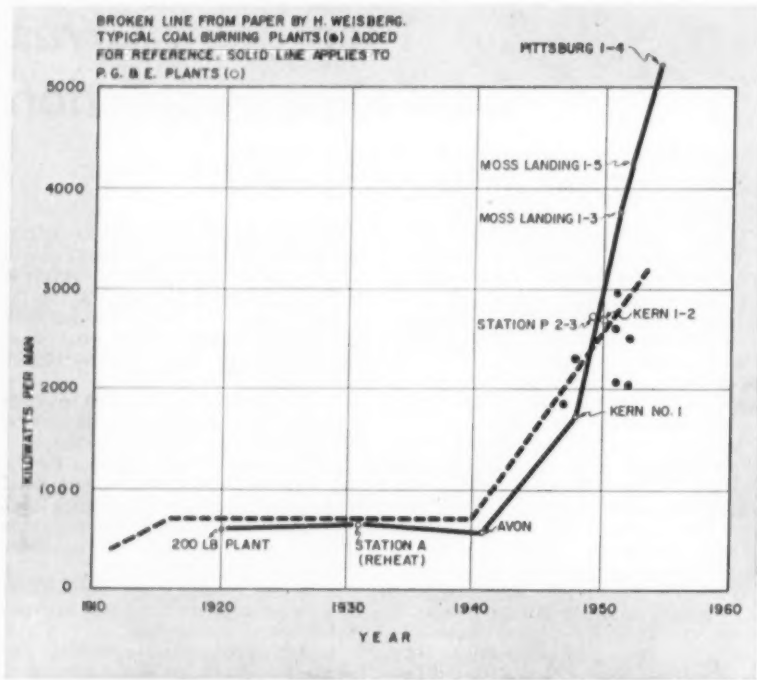


Fig. 1. Trends in operating manpower requirements for coal-burning plants (broken line) and PG & E's oil- and gas-burning plants (solid line). Data on coal plants are from a recent paper by Herman Weisberg

MUCH THOUGHT has been devoted to the economics of improved heat cycles and considerable ingenuity has been shown in holding initial investment costs to a minimum for the more elaborate systems. The problem of manpower costs does not lend itself so readily to scientific analysis, however, and this is partly due to the difficulty of evaluating human factors. Nevertheless, it is possible to arrive at a reasonable evaluation of the more important components in the plant layout and management policies which bear directly on such manpower costs. V. F. Estcourt, General Superintendent of Steam Generation, Pacific Gas and Electric Co., integrated many of the pertinent factors in a recent paper (No. 53-A-95) presented before the ASME in New York. The following material was abstracted for the most part from that authoritative paper.

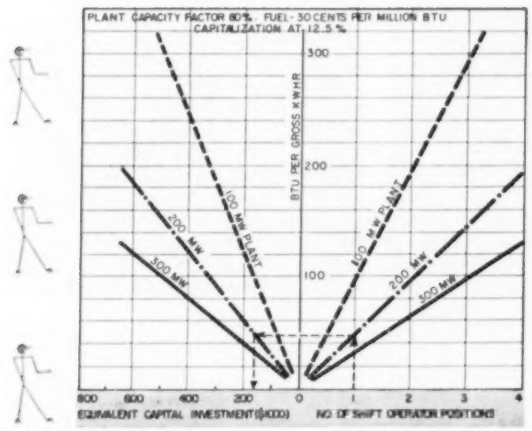
In Fig. 1, the broken line represents the trend of coal-burning plant capacity per man, and is based on a paper presented by Herman Weisberg before the 1952 ASME Annual Meeting. The solid line shows the actual trend for PG & E's system for oil- and gas-burning plants. To correlate these figures, assume that about 15 to 20 per cent more manpower is required in a coal-burning station. These trends are the result of larger units and the increased use of centralized control as well as improved auxiliaries.

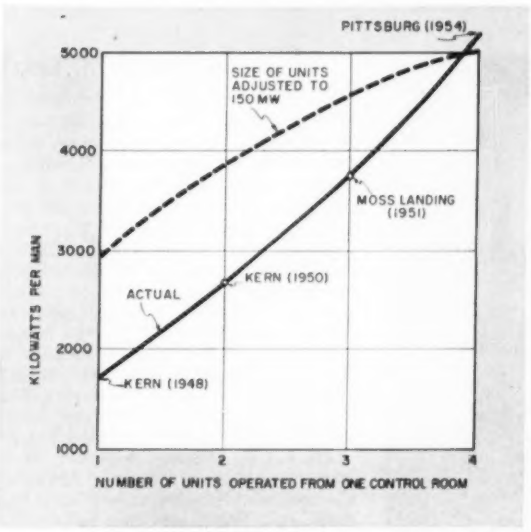
Although PG & E had adopted fully-centralized control by 1940, no immediate savings in manpower were effected. The solid line in Fig. 1, however, shows impressive savings commencing in 1948 despite special features permitting quick load pick-up which would normally depress the curve and undoubtedly did so.

Plant design, arrangement of equipment and management policies determining operator coverage and training, all have a pronounced effect on operating manpower costs and can be evaluated with reasonable accuracy. First, it is interesting to consider a change in cycle heat rate or a change in the number of shift operators in terms of their equivalent costs, or each in terms of a break-even investment cost. Such a comparison is shown in Fig. 2, wherein these equivalent costs are given for plants ranging in size between 100 and 300 mw and operating at 80 per cent capacity. This chart shows that the addition of one man per shift would nullify the fuel savings resulting from a gain of about 33 Btu per kwhr in cycle efficiency for a 300-mw plant, or nearly 50 Btu for a 200-mw installation. These figures are based on operating labor costs on the Pacific Coast and must be modified elsewhere with local labor, fuel and plant load factors.

Theoretically, it takes 4⅕ shift operators to fill one operating position for seven days per week around the clock. When vacations, sick leave and possible shift premium pay are considered, the total cost is usually the equivalent of 4½ to 4⅔ times the base pay of the payroll classification of each shift operator position. This may be further increased by the need for a training pool to take care of replacements resulting from resignations or upgrading due to system growth. The size of such a pool would be affected by the number of regular operators on the payroll.

Increasing the size of units will, generally, increase the output per man. Consolidating the controls of many units in one control room will have a similar effect. Each of these developments is dependent on the other for full realization of its potential effect on manpower costs. Fig. 3 illustrates the effect of increased unit size, and is based on the requirements of four 156 mw units at PG & E's Pittsburgh Steam Plant. In this case, increasing the size of the units to 200 mw would raise the output per man to about 6300 kw, while decreasing the size to 50 mw would decrease the output to 1900 kw per man.





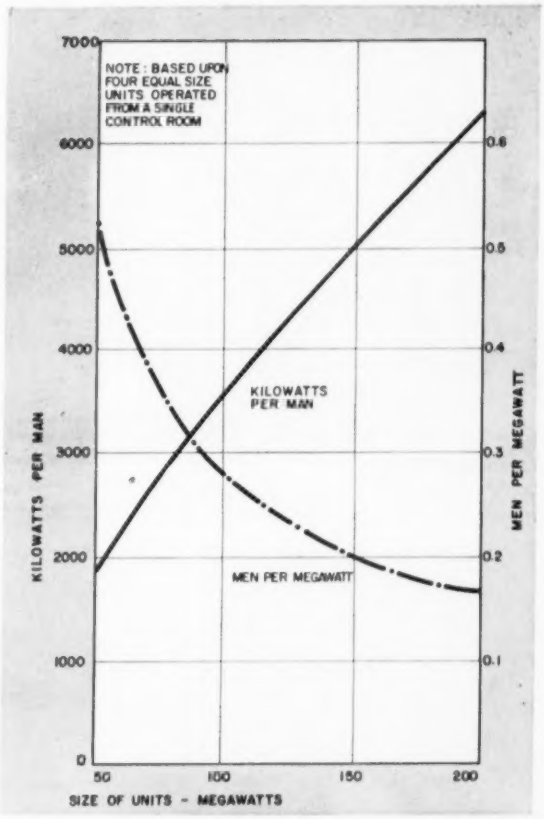


Fig. 2. (Above left) Equivalent values of plant heat rates, investment and manpower costs based on cost figures prevailing on the West Coast. Example shows saving one shift operator justifies $1,600,000 investment

Fig. 3. (Above) Effect of size of units on operating manpower requirements, assuming four equal-sized units operated from one control room. This 50-mw plant produces 1900 kw per man; 200-mw plant, 6300 kw

Fig. 4. (Left) Effect of the number of units per control room on operating manpower, based on actual data from PG & E plants. Broken line shows the same data adjusted to represent the trend if all units are same size

Figure 4 illustrates what actually was accomplished in some stations by increasing the concentration of controls in a single control room. The solid line represents the kw per man output of stations with one, two, three, and four units per control room, the output varying from 1700 kw per man with one unit to 5200 kw per man with four units. The broken line represents a more realistic picture of these benefits since it eliminates the influence of gradual increases in size of the units over the years. This is done by assuming all units are 150 mw and adjusting with factors from Fig. 3.

Increasing the number of units per control room would eventually lead to diminishing returns because of the distances from the control room and the necessity of additional operators to tend the more remote units. This would certainly reduce and possibly eliminate any benefits accruing from control centralization. Add to this consideration the danger of a catastrophe wiping out the entire control system, and the difficulty of planning and justifying the design of a control room for many units to be added at a much later date, and it is easy to see that centralized controls have a definite limitation.

An additional shift operator will usually be required to look after pulverizers, feeders and ash-handling equipment when coal fuel is burned. When more than one fuel is burned at the same station, no extra trouble is encountered except during the changeover from one fuel to the other. Sporadic availability of dump gas in some areas may require several changeovers each day during the spring and fall months; hence, an operator or more must be on hand for this duty. PG & E recently instituted a mass change-over plan for the burners in their oil/gas burning boilers. With the aid of television and remote control, change-over time was cut from 20 minutes per boiler to 3 or 4 minutes, without extra men.

Automation, instrumentation and mechanization are most easily justified where great activity is required periodically or on load change demands such as are encountered in the preceding example. Changing fuels or putting additional units on the line make demands on the operating personnel far beyond normal requirements. In many plants, at least one extra man is required to cover such emergencies and prevent mishaps.

The extent of reliance placed upon controls will have a decided effect on manpower costs. In one plant where extreme reliance is placed on controls, two men operate and patrol the entire main floor and switchyard area in the 600,000 kw station. In this case, at least one man per shift was saved by locating the boiler feed pumps and evaporators on the control room floor.

Your editors are reminded of the British station which reported such a high degree of automation and instrumentation that only two men were required to operate the plant. Actually, they reported, only one was really necessary, but they would look terribly silly if the blighter dropped dead and there were no one around the place to report it.

Fig. 1. Street scene in village of Taxco, Mexico, to which delegates were driven by Mexican ASME

Fig. 2. Fleet of "Mexican Cadillacs" (burros), is a familiar sight on roads outside of Mexico City

Fig. 3. Another view in the village of Taxco where silver is mined and silver products are handmade

Here & There in Mexico

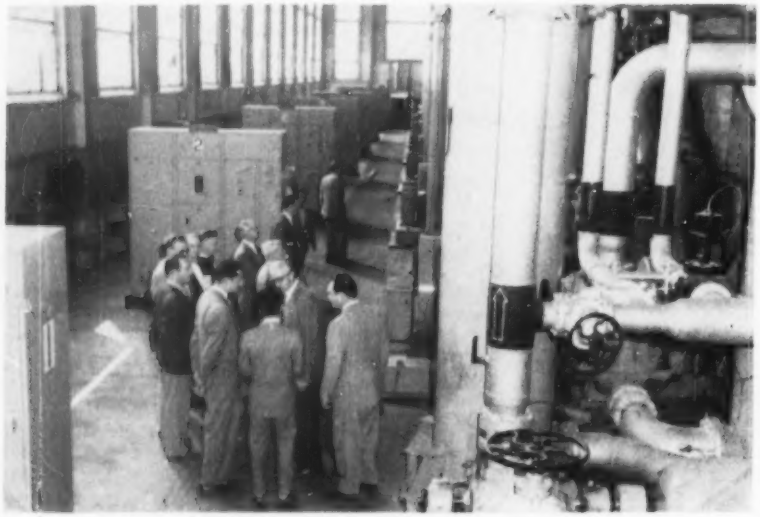


Fig. 4. During an inspection by ASME visitors at Tacubaya Diesel Plant at Mexico City, its superintendent, Max O. Bunge (in dark-rimmed glasses), explains operation of auxiliary equipment to interested group

By CHESTER R. EARLE
Executive Editor, POWER ENGINEERING

THROUGH clear sunny skies on March 8 and clear star-lit skies on March 9, two great American DC-6's roared southward across the continent to the big municipal airport at Mexico City, D. F. They carried from various parts of the United States a delegation of 48 ASME members, most of them accompanied by their wives. This delegation deplaned at Mexico City into the hospitable arms of the Mexico Section of ASME, assisted by the courteous and efficient Mexico Travel Advisors. The occasion was the International meeting of ASME at the Hotel del Prado.

On March 17, they re-planed to return to the United States. Many of the men had "museum feet" and bad sunburns. The wives were laden with genuine Mexican silver jewelry and other art objects, colorful handwoven baskets, beautiful serapes. Everybody had a memorable time.

Fig. 5. Some of the ASME visitors to the Lecheria Steam Plant inspect the boiler control board for one of 325,000-lb-per-hr, 900-psi, 910-F boilers

Fig. 6. In the Lecheria Steam Plant, Mechanical Engineer E. Arechavala explains details to visitors. On his right, Chester R. Earle, Executive Editor

Fig. 7. A portion of audience at inauguration of the International ASME meeting on March 10

Fig. 8. At inauguration, a representative of President Cortines of Mexico officially welcomes the delegates. At his left Lewis K. Sillcox, president ASME, and George Camp, chairman, Mexico Section ASME

At the technical sessions, interesting papers were given on the engineering of paper and sugar factories, diesel railway power, sulfur mining, metal processing and lubrication.

Señors Fuentes and Almanza, with W. J. Rheingans, presented a paper on the 39,000-hp vertical impulse hydraulic turbine installed in San Bartolo plant. Of particular interest was a paper on diesel plant design by Robert Cramer, Jr. emphasizing ventilation problems of the Tacubaya Diesel Plant in Mexico City and discussing influence of fuels and higher engine ratings. An important paper on the performance and maintenance of this Tacubaya plant was presented by J. K. Jennings, Technical Director of the Mexican Light & Power Co.

Lecheria Steam Plant (see Figs. 5, 6, 10 and 11) is new, contains two 33,000-kw turbine generator units supplied with steam at 900 psi, 910 F by two semi-outdoor type boilers each of 325,000 lb per hr capacity, fired by Bunker "C" oil or gas.

Fig. 9. American ASME members at the Tacubaya Diesel Plant. Left to right; James Turman, Chester R. Earle, Max O. Bunge, Edgar J. Kates, David Duff, F. D. Whisler, Frank M. Gunby and T. A. Labrecque

Fig. 10. American and Mexican ASME members visiting Lecheria Steam Plant in Mexico stand beside one of two 33,000 kw steam turbine generating units. Extreme left: José Tovar, in charge of station

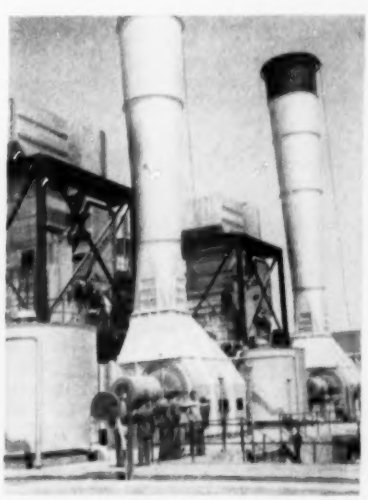


Fig. 11. Here are the two semi-outdoor 325,000 lb-per-hr boilers installed at Lecheria Steam Plant

USE Standard Crane Signals for SAFETY

Many accidents happen because signals made by the man on the ground are not properly understood by the crane operator. Standard signals such as these outlined by Harnischfeger will help prevent misunderstandings

Reprints of article CRANE ACCIDENTS CAN BE PREVENTED, giving complete instructions for safe crane operation, are still available. To obtain copies, write the Editor, or use one of the prepaid post cards elsewhere in this issue

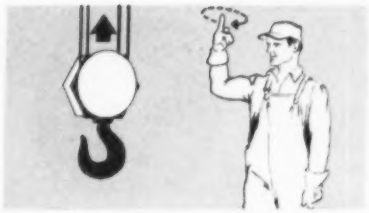


Fig. 1. To Hoist—Keeping forearm vertical as shown, make small horizontal circles with the hand

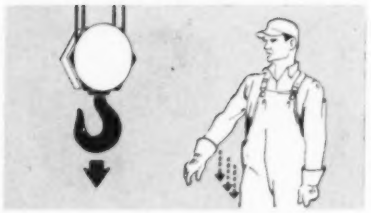


Fig. 2. To Lower—Extend arm downward, keeping the hand below hip and wave forearm downward

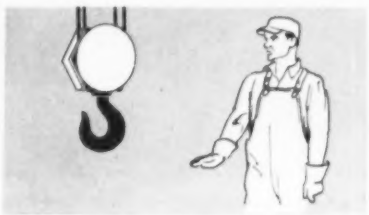


Fig. 3. Stop—Extend arm as shown, keeping hand level with the hip and hold this position rigidly

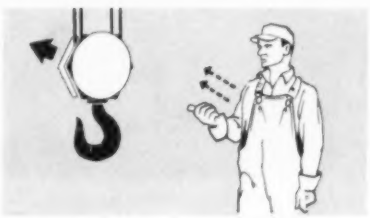


Fig. 4. Rack—Extend arm, close fingers, extend thumb, and jerk hand in the direction of racking

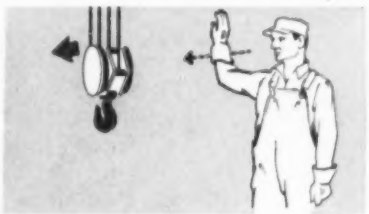


Fig. 5. Travel—Extend forearm vertically with hand open and wave forearm in direction of travel

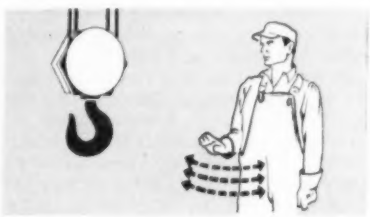


Fig. 6. Emergency Stop—Extend arm with hand level with hip and wave quickly to right and left

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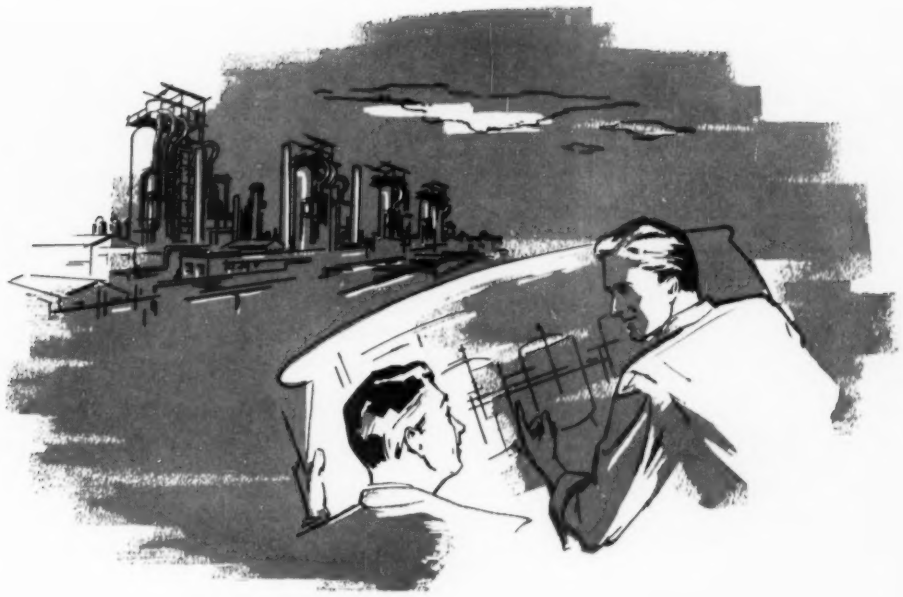
MISGUIDED MISSILE

A CURIOUS accident that happened recently in the Midwest emphasized the importance of handling gas cylinders carefully.

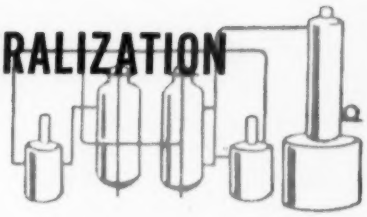
A high-pressure gas cylinder had its protective cap removed while on the pile of cylinders. When being removed from the pile the cylinder slid to the ground and the unprotected valve assembly broke off. The jet of gas released from the valve stem forced the cylinder through the air into the rear of a parked automobile, out through its windshield, over two houses and against the foundation of a home fifteen hundred feet away.

This accident was reported in the Sept–Oct 53 issue of *Shipyard Bulletin*, and though it happened in the Midwest, mishandling could cause a similar accident anywhere. Remember that compressed gas cylinders should never be dropped; they should never be placed in a position where they may be struck or overbalance and fall over; they should never have the protective cap removed from the valve unless gages and hose are ready for attachment; they should be placed in well ventilated areas away from sources of heat, and they should be kept closed when empty.



HIGHER WATER PURITY BY DEMINERALIZATION

....A Cochrane *Achievement*



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PRACTICAL ENGINEER and ELECTRICIAN SECTION

Contents

Guide to the Selection of Electric Motors 94
Forming Solid Loop Wire Terminals 96
QUESTIONS AND ANSWERS 98–104

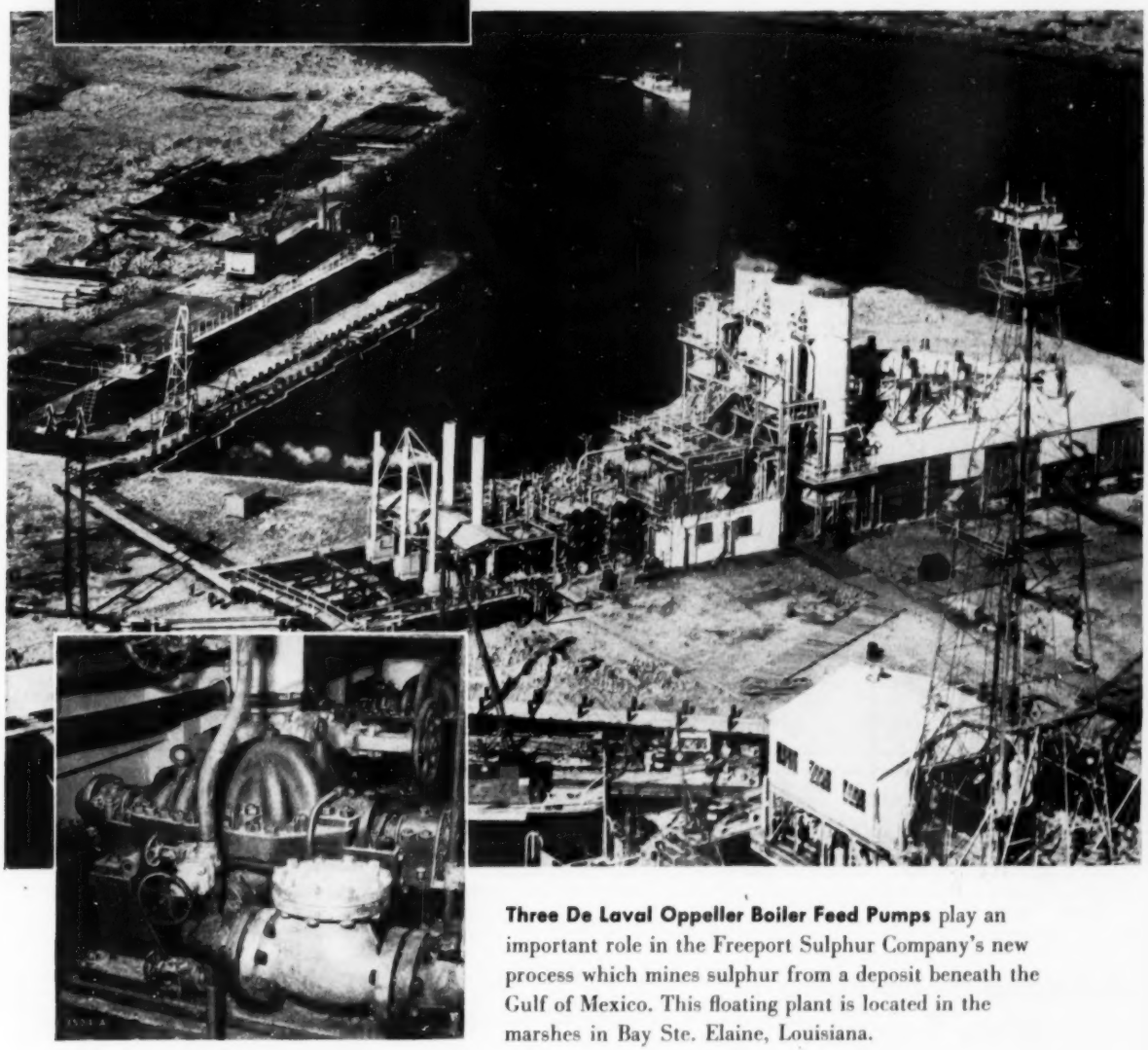
Guide to the Selection of Electric Motors

Type	Starting Characteristics	Speed Regulation	Speed Adjustment *	Application
1. D-C. Shunt.	Medium starting torque, 150% at 150% rated current. Starting rheostat must be used.	Close (0–8%).	By field rheostat from 10% below to 25% above rated speed.	Suitable for steady loads. Lathes, shapers, planers, drills, milling machines, stokers, blowers, centrifugal pumps, line shafts, woodworking machinery, printing presses, conveyors, screw machines.
2. D-C. Series.	Very heavy starting torque, 300–400% at 175–200% rated current. Starting rheostat must be used.	Very wide.	Short-time speed adjustment by use of series rheostat (starting rheostat). On cars and locomotives by series or parallel connection of motors.	Locomotives, street cars, cranes, hoists, small air compressors, small fans. Must be positively connected to load.
3. D-C. Compound (Cumulative).	Intermediate between (1) and (2). Starting rheostat must be used.	Moderately wide (10–25%).	Same as (1).	Suitable where sudden momentary overloads are like'y to occur. Punch presses, large shears, compressors, conveyors, passenger elevators, crushers.
4(a). A-C. Polyphase squirrel-cage induction, normal torque, normal starting current.	Medium starting torque, 125–150%. Starting compensator, or starting resistors should be used in sizes above 5 hp.	Close (2–6%).	None.	The simplest and most widely used of all motors. Suitable for wide variety of loads not requiring speed adjustment. See (1) for applications.
4(b). A-C. Polyphase squirrel-cage induction, normal torque, low starting current.	Starting torque less than 4(a), 100–150%. Designed to start on full line voltage. No compensator necessary.	Same as 4(a).	None.	Applications same as 4(a).
4(c). A-C. Polyphase squirrel-cage induction, high torque, low starting current.	Heavy starting torque, 175–250%. Line start as 4(b). Must not be started at too frequent intervals.	Close (2–6%).	None.	Pumps, compressors, conveyors, crushers, pulverizers, shears.
4(d). A-C. Polyphase squirrel-cage induction, high slip.	Heavy starting torque, 200–275%. Line start as 4(b).	Wide (8–12%).	None.	Suitable where momentary overloads are likely to occur intermittently. Punches, shears, power hammers.
5. A-C. Polyphase wound-rotor (slip-ring) induction.	Heavy starting torque, 200–275%. Started with external resistors in rotor circuits. These are short-circuited when speed reaches normal.	Close (2–5%) with rotor resistors short circuited. Regulation is wide with resistors in circuit.	Speed may be reduced below normal over wide range with rotor resistors. (Efficiency also reduced.)	Suitable for heavy and frequent starting duty. Also for adjustable speed applications. Elevators, cranes, reciprocating compressors, steel mills, hoists, conveyors, crushers, pumps, blowers.
6. A-C. Polyphase commutator, brush-shifting.	Heavy, 150–200%.	Wide (10–30%).	Speed may be varied over wide range by shifting brushes.	Fans, compressors, pumps, stokers, textile machinery. First cost of motor is high.
7. A-C. Polyphase synchronous.	Medium starting torque, 80–125%, depending on construction and cost of starting windings. Some motors require compensator for starting, others start directly across line.	Constant speed.	None.	Suitable (1) where maximum possible operating efficiency is desired for steady continuous loads of 75 hp and over, (2) where exactly constant speed is necessary, (3) where motor speeds of less

Continued on page 96

DE LAVAL
OPPELLER
PUMPS

are used for boiler feed on floating process plant



Three De Laval Oppeller Boiler Feed Pumps play an important role in the Freeport Sulphur Company's new process which mines sulphur from a deposit beneath the Gulf of Mexico. This floating plant is located in the marshes in Bay Ste. Elaine, Louisiana.

The De Laval Boiler Feed Pumps operate at 3,500 rpm with water heated to 297F. They are built with 12% chrome steel impellers and trim. The dependable performance of these units has led Freeport Sulphur to purchase six additional pumps for boiler feed service at two other mines. In addition to boiler feed, De Laval Oppeller Pumps are used throughout industry for mine dewatering, descaling, desuperheater feed as well as for services in the petroleum, pipeline and marine fields. Capacities range up to 2,000 gpm, pressures to 1,200 psig, temperatures to 350F; materials to suit any service. For complete data, send for Catalog 1502.

DE LAVAL *Oppeller Pumps*

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Continued from page 94

Type	Starting Characteristics	Speed Regulation	Speed Adjustment *	Application
				than 500 rpm are required in sizes of 20 hp and larger, (4) where power factor improvement is desired. Compressors, centrifugal pumps, motor-generater sets, line shafts, cement mills, paper mills, steel mills.
8. A-C. Single-phase repulsion.	Heavy starting torque, 200–300%.	Wide, similar to series motor.	None on most machines.	For loads involving heavy starting torque or sudden overloads. Printing presses, fans, blowers. Range ½ to 15 hp.
9. A-C. Single-phase repulsion-induction.	Heavy starting torque, 200–300%.	Medium (4–8%).	None.	Same as 8. Speed of this motor more constant than 8.
10(a). A-C. Single-phase induction, repulsion start.	Heavy starting torque, 300–400%.	Close (3–6%).	None.	Widely used general purpose motor in range from ¼ to 15 hp, for applications where heavy starting torque is required. Compressors, stokers, pumps, conveyors, many types of farm machines.
10(b). A-C. Single-phase induction, split-phase start.	Medium starting torque, 75–150%.	Same as 10(a).	None.	Widely used general purpose motor in range from 1/20 to ¼ hp, for applications not requiring heavy starting torque. Domestic washing machines, oil burners, wood-working tools, business machines, grinders, etc.
10(c). A-C. Single-phase induction, capacitor start.	Heavy starting torque, 250–350%.	Same as 10(a).	None.	Application and range similar to 10(b) but especially adaptable to loads requiring heavy starting torque. Domestic refrigerators, stokers, compressors, oil burners.
10(d). A-C. Single-phase induction, capacitor start and run.	Same as 10(c).	Same as 10(a).	Speed may be changed over wide range by varying impressed voltage, or by changing taps on main winding.	Fans, blowers, in unit heaters, etc.
11. A-C. Single-phase, shaded-pole.**	Low starting and running torque.	Some types operate at constant speed; others with considerable regulation.	None.	For very small torque applications, desk fans, electric clocks, valve-operating mechanisms, etc.
12. A-C. Single-phase, series (universal motor).	Very heavy starting torque, 300–400%.	Very wide.	Same as (2).	In large sizes, for electric locomotives, traction, cranes, hoists. In fractional hp sizes, for fans, domestic vacuum cleaners, etc.

* The speed of most motors, except synchronous motors, may be varied by changing the impressed voltage by means of line impedances or transformers. This method of speed control has not been included under the heading "Speed Adjustment."

** There are many variations in type, characteristics, and applications of shaded-pole motors. Hence no attempt has been made to make the description in section 11 complete.

Forming Solid Loop Wire Terminals

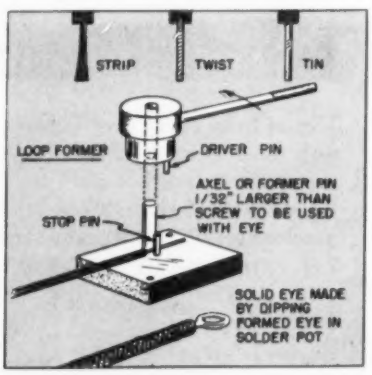
By CHARLES H. WILLEY

QUITE OFTEN in overhauling existing equipment or installing new wiring, it is desirable to make electrical connections with an extra margin of safety. The simplest way of accomplishing this is to use closed loop terminals on conductors, especially if a convenient former is available.

We made a former such as that shown in the accompanying sketch, and found it so handy that we now have an assortment for the various wire sizes. Obviously, this sort of device is more appropriate for large jobs than for single connections. Using it, we can form loops quickly and neatly as follows:

1. Strip conductor to bare enough for the loop.
2. Twist the conductors (if multi-wire).
3. Tin the wire with soldering iron or solder pot.
4. Place tinned wire between axle pin and forming pin. Drop forming head on axle pin and roll wire around the forming pin.
5. Dip entire loop into solder pot to form solid loop.

The forming pin should be $\frac{1}{32}$ in. larger than the screw or bolt which will secure the connection, but other dimensions are not critical. Distance between the axle and driving pins must be great enough to allow for wire to wrap around forming pin.


STRIP
TWIST
TIN
LOOP FORMER
DRIVER PIN
AXEL OR FORMER PIN 1/32" LARGER THAN SCREW TO BE USED WITH EYE
STOP PIN
SOLID EYE MADE BY DIPPING FORMED EYE IN SOLDER POT

Loop former is shown here with sequence of steps in making a solid loop terminal for a conductor. It is especially useful in large wiring projects

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QUESTIONS AND ANSWERS

Why the Red Faces? (Question No. 513-A)

THERE ARE times when even an editor sleeps. When this is confined to the commuter train, bed or editorial meetings, no one gets excited. But when he snoozes while checking out calculations in heat transfer problems, he discovers that people actually read the book. Yours truly will have insomnia for a year following the latest batch of letters and phone calls in tolerant protest of H. B. Wayne's answer to Question No. 513 ("How to Figure Air-Cooled Steam Condenser") published in our February issue.

Mr. W. H. Motz, Supervising Engineer of the Jefferson Ice Co. here in Chicago, was the first to call. He referred us to his book "Principles of Refrigeration," which carries a concise treatment of heat exchanger calculations. His comments and his results were so similar to those of K. Whitby of Lancashire, England, that we will print here only Mr. Whitby's letter and Mr. Wayne's reply to Motz' comment.

Whitby's Commentary

I ENJOYED reading your contributor's reply to A.L.A. (Q. No. 513), which is given in a concise and easy-to-follow fashion.

However, to my mind there seems to be just one misleading point, apart from the typographical error near the foot of the first column on page 88 (138,000,000 Btu per hr instead of 13,800,000 Btu per hr).

In the table devoted to the condenser performance data the author refers to the overall heat transfer coefficient (item 15) as 16 Btu per sq ft per deg F per hr. He then proceeds to use this figure in calculating the surface required — but the temperature difference he uses is the rise in air temperature. Surely, unless he defines heat transfer differently from myself, this cannot be true.

The saturation temperature at 3 in. hg is 115 F, and with air "in" and "out" temperatures 95 and 105 F respectively, the mean temperature difference by which heat is transferred from the condensing steam to the cooling air is logarithmically and precisely:

$$\text{LMTD} = \frac{(115-95)-(115-105)}{\log_e \frac{115-95}{115-105}} = \frac{10}{\log_e 2} = 14.4 \text{ F}$$

A more simple and slightly less precise method gives:

$$\text{MTD} = \frac{(115-95)+(115-105)}{2} = \frac{30}{2} = 15 \text{ F}$$

Using the more precise mean temperature difference, the surface area becomes:

$$= \frac{13{,}800{,}000}{16 \times 14.4} = 59{,}900 \text{ sq ft}$$

It will be interesting to have Mr. Wayne's comment on this point.

Lancashire, England — K. WHITBY

Wayne's Comment On This Point

YOUR air mail letter stated Mr. Motz questioned the value of temperature difference given in Equation 16, page 89, February issue. Mr. Motz is correct in his comment.

For a heat exchanger designed to permit the hot fluid (steam) to give up heat but having the temperature remain constant, and the cold fluid (air) absorb heat with rising temperature, the logarithmic mean temperature difference should be used for calculating the required surface.

I check the value of 14.4 F given in your letter as correct and therefore the required surface area is 59,900 sq ft.

May I thank Mr. Motz for observing this error and I hope that this inaccuracy has not caused any inconvenience for A.L.A., who requested this information.

The Editor says his face is a little red. My face is *really* red.

Brooklyn, N. Y. — H. B. WAYNE

Editor's Note: — And we add our thanks to Mr. Whitby and those others who caught our slip.

Answer to No. 511

What Causes Water Hammer In This Tailpipe?

Editor's Note — The original question submitted by E. E. M. appeared in the August, 1953, issue of POWER ENGINEERING and still has not been satisfactorily solved. A couple of times it was thought to be solved, but changed operating conditions would start the hammer all over again. Also, we are still receiving suggestions from you readers on this old problem. We will let you know when it has been finally corrected and tell how it was done.

Fill Up That Tailpipe — Fischer

I BELIEVE that the solution of the problem is that shown in Fig. 7, page 95, December issue. That is, raising the tail pipe water level, though I would suggest that this be done by raising the hot fill and providing it with a suitable overflow as this arrangement would be self-regulating and not require adjustments for variations in quantity of condensing water.

My explanation of the phenomena is:

All steam pipe water hammers are the result of the condensation and collapse of vapor bubbles, letting the surfaces of the water surrounding the former bubble come into violent contact, with impact.

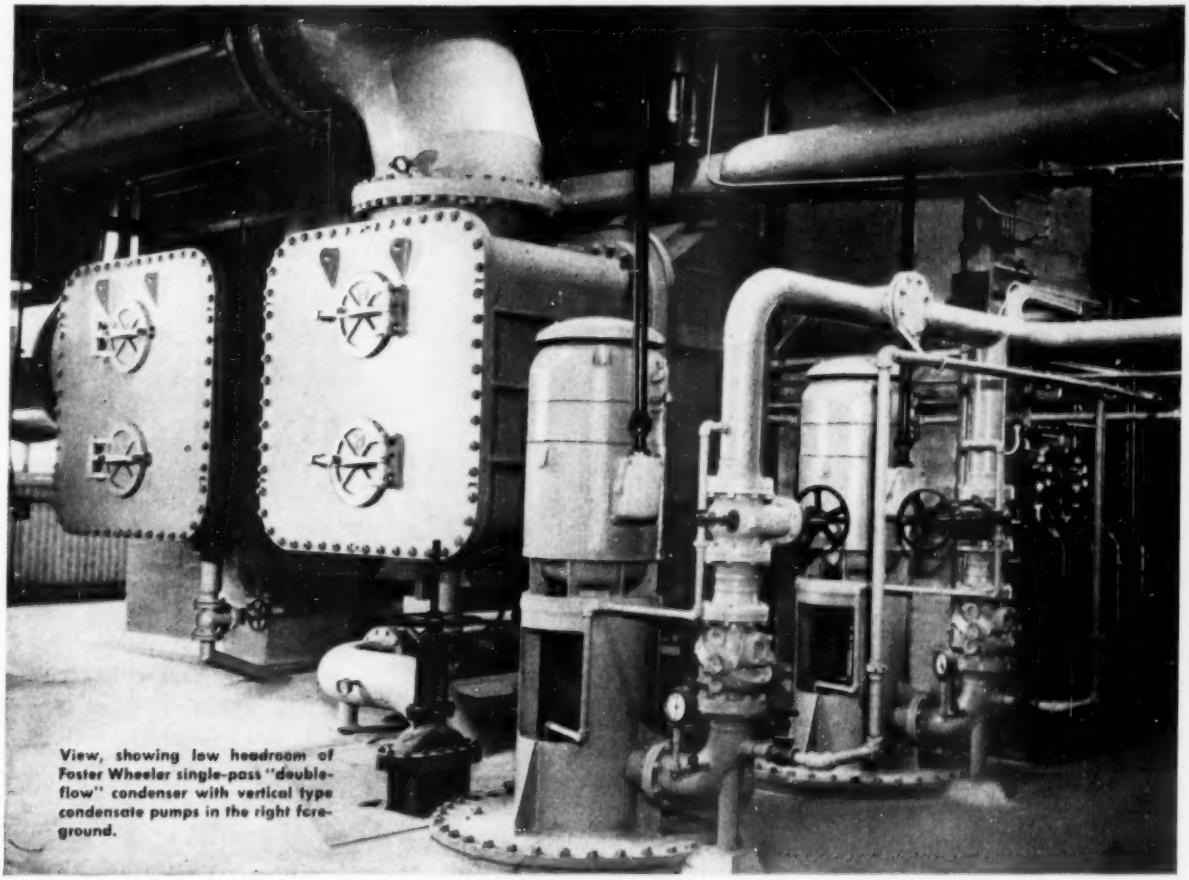
With a tail pipe of 60 ft 5 in. plus above the surface of the water in the hot well a vacuum of 27.8 in. Hg will maintain a solid column of water in the tail pipe of roughly 30 ft 6 in., above which will be approximately 30 ft of vapor-filled space, except where it is filled with the falling column of condensing water.

The inference from the description of the equipment is that the vacuum is regulated by increasing or decreasing the flow of condensing water, with a greater or smaller rise in temperature and a vacuum corresponding to the final temperature of the water plus the condenser operating temperature difference which is stated by the Heat Exchange Institute as 5 F for this sort of equipment. For 27.8 in. vacuum this would mean a water temperature leaving the condenser of about 107.5 F.

Up to the flow required to maintain the 27.8 or 28.4 in. vacuum, the flow of condensing water is apparently small enough that it can fall freely through the vapor space of the upper portion of the tail pipe without fully filling the pipe. When the flow reaches or exceeds this amount, at times gulps of the water fill the pipe fully and form pistons descending through the tailpipe. These pistons compress the vapor so that its saturation temperature is above that of the water which surrounds it and it immediately condenses, its weight and latent heat being very small as compared with the weight and heat capacity of the water surrounding it. As a result, the falling plug of water strikes the surface of the water column in the tailpipe without any cushion and drives it, or attempts to drive it, down the tailpipe. The first obstruction to the flow of this column in the tailpipe is the elbow at the bottom of the column and the impact appears at this point, just as in a water hammer in a horizontal steam pipe the elbow or valve is blown off the end of the pipe.

I believe because of the lessened resistance at the bottom of the tail-

SHORTER on headroom - LONGER on savings



View, showing low headroom of Foster Wheeler single-pass "double-flow" condenser with vertical type condensate pumps in the right foreground.

New Foster Wheeler "double-flow" condenser uses 40% less headroom – cuts building costs – more than meets the highest performance standards

Utilizing a volume only 60% of that customarily required, the new Foster Wheeler "double-flow" principle marks a new advance in condenser design. Less headroom is required—often 40% less than the over-all height of conventional units. This means a proportionately shorter turbine pedestal—and a substantial reduction in building costs.

The rectangular shape makes possible complete utilization of the space available. Intimate contact and scrubbing action between steam and condensate promote effective deaeration and reheating. Condensate leaves the hotwell at steam temperature under all operating conditions. Also, because of the larger steam entrance and shorter tube-bank depth, pressure loss is reduced to a minimum. Efficient cooling of the non-condensate vapors and gases is provided by triangular cooler sections of the series zone type.

In a typical test of a 32,500 sq. ft. unit, the actual heat transfer coefficient showed 578 Btu per hr. per sq. ft. per F as against 510 for commercially clean tubes,—thus resulting in an absolute pressure 0.10 inch better than expected. Further details on request.

FOSTER WHEELER CORPORATION
165 Broadway, New York 6, N. Y.

FOSTER WHEELER

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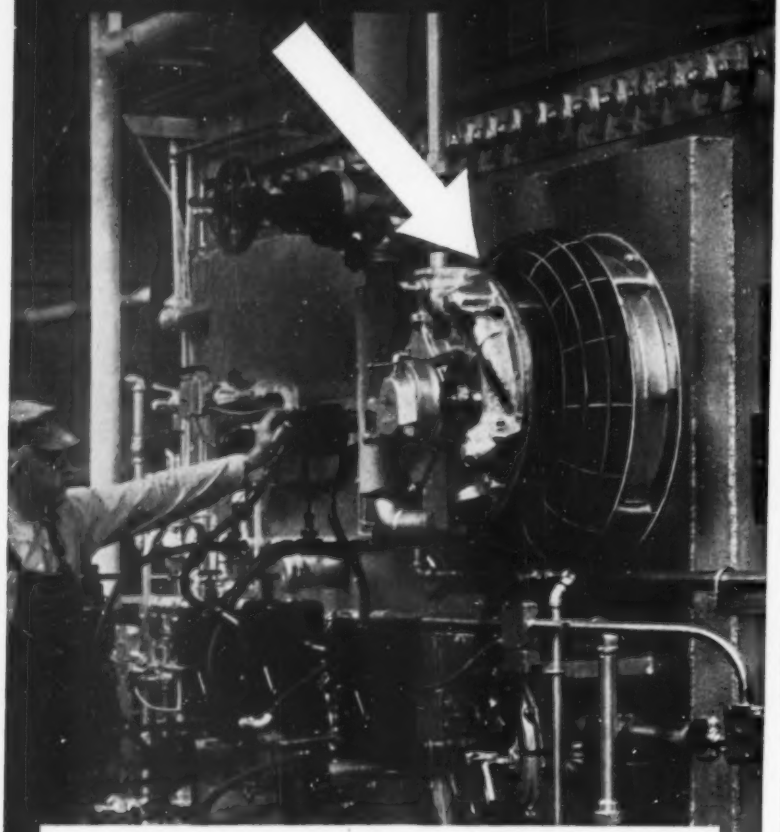
Only a WING Axial Flow Turbine Blower would permit such a compact installation



THIS neat, compact forced draft installation shows how the WING Axial Flow Turbine Blower can save thousands of dollars in installation costs by eliminating the duct work and excavation costs attendant on the use of other types of blowers. This compact, quiet, low-speed blower delivers 11,300 CFM at 3" static pressure to the 40,000 lb. per hr. B & W oil-fired boiler at the Chicago plant of Southern Cotton Oil Co., makers of the well-known Wesson Oil. This is the third Wing blower at the Chicago plant, the tenth in all Southern Cotton Oil plants, the first having been installed in 1916.

Wing

L. J. Wing Mfg. Co.
64 Vreeland Mills Road
Linden, N. J.
Factories:
Linden, N. J. and Montreal, Can.

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Questions and Answers

continued from page 98

pipe after the two 90-degree ells were changed to 22½-degree ells the impacts of the falling plugs of water drove a certain amount of the tailpipe column on and into the hot well and the water hammer was less noticeable until the flow was still further increased and the falling plugs of water became larger and more frequent.

I think this hypothesis explains why all the air vents, etc., had no effect as nearly all the air was being drawn off by the air ejector and there was no free air to be vented, the very small amount left probably being suspended in the water as very fine bubbles. A further supporting argument would be that since air will not condense but will still retain an appreciable volume, even though compressed, it would tend if anything to cushion a water hammer. This venting of air elsewhere is confirmed by the statement that the system operated at first with a closed hot well which indicates little air and be present in the absence of water hammer when the steam ejectors were turned off and the condensing water above ran through the condenser as there would be no vapor to form and collapse to form the water hammer.

I therefore believe that if E. E. M. will rearrange his equipment so that the water level in his hot well will be about 35 ft or 36 ft below the center line of the 16 by 14-in. reducer on the inlet of the tee at the top of the tailpipe he will overcome his troubles from water hammer.

New Haven, Conn. H. D. FISCHER

Answer to No. 517

How Patch Underground Oil Storage Tank?

Use Concrete—Fitzpatrick

SOME TWENTY odd years ago we had much the same problem with a No. 6 fuel oil tank leaking. Welding was initially considered and the explosion and fire hazard to be minimized by filling the tank completely with carbon dioxide.

After checking the maximum 5 psi pressure that would have to be closely maintained to prevent tank bursting, we decided on this repair.

First, the tank side was cleaned as much as possible with an alkaline detergent solution, and previous paint removed with coarse steel wool. A concrete form was made to cover the crack extending 12 inches on each side.

Tarred oakum was calked into the crack just tight enough to keep in place and a fast drying asphalt paint was applied to the oakum. While the asphalt was still tacky, waterproof canvas strips were lapped over the oakum for a one-foot additional coverage on each side of the crack.

years of safe, sure, efficient lubrication ahead for these turbines with GULFCREST OIL

Modern equipment in a modern plant—line up of six large General Electric steam turbines in the O. H. Hutchings Station of the Dayton Power & Light Company generating plant which is located south of Dayton, Ohio, on the Miami River. Gulfcrest Oil provides the vital lubrication for all six units.

Gulfcrest's unmatched record of outstanding performance in every type of steam turbo-generator guarantees safe, sure, efficient protection for these six units down through the years.

A record like this did not just happen. It is the result of careful selection of crude oils that are thoroughly refined, then super-refined by Gulf's exclusive Alchlor Process—plus the right combination of the right chemical additives, and rigid quality control.

Gulfcrest's performance record includes installations where the original fill has been in service more than 15 years.

The next time you fill a turbine system, make it a fil! for safe, sure, long-lasting protection. Specify the world's finest turbine oil—Gulfcrest. Call your nearest Gulf office today and have a Gulf Sales Engineer recommend the proper grade.

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1822 Gulf Building Pittsburgh 30, Pennsylvania

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looking in . . .
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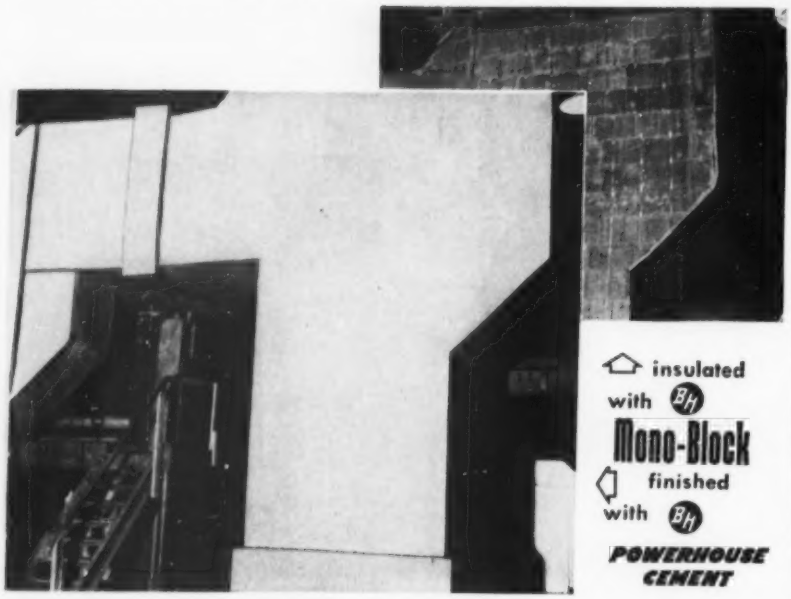

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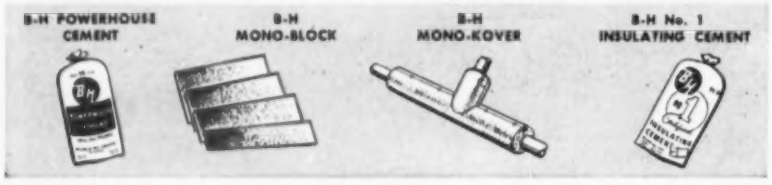

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Questions and Answers

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Another coat of asphalt was applied over the strips and allowed to dry thoroughly. Then, a mix of fast-drying non-shrink cement, 1–2–4 was formed 6 inches deep over the canvas strips.

The concrete dried and set rapidly and the tank has never leaked.

Jefferson City, Mo.

L. W. FITZPATRICK

Answer to No. 520

How To Avoid Undue Noise in Air Ducts?

Isolate Vibrations, Check Velocities and Turbulence—Fitzpatrick

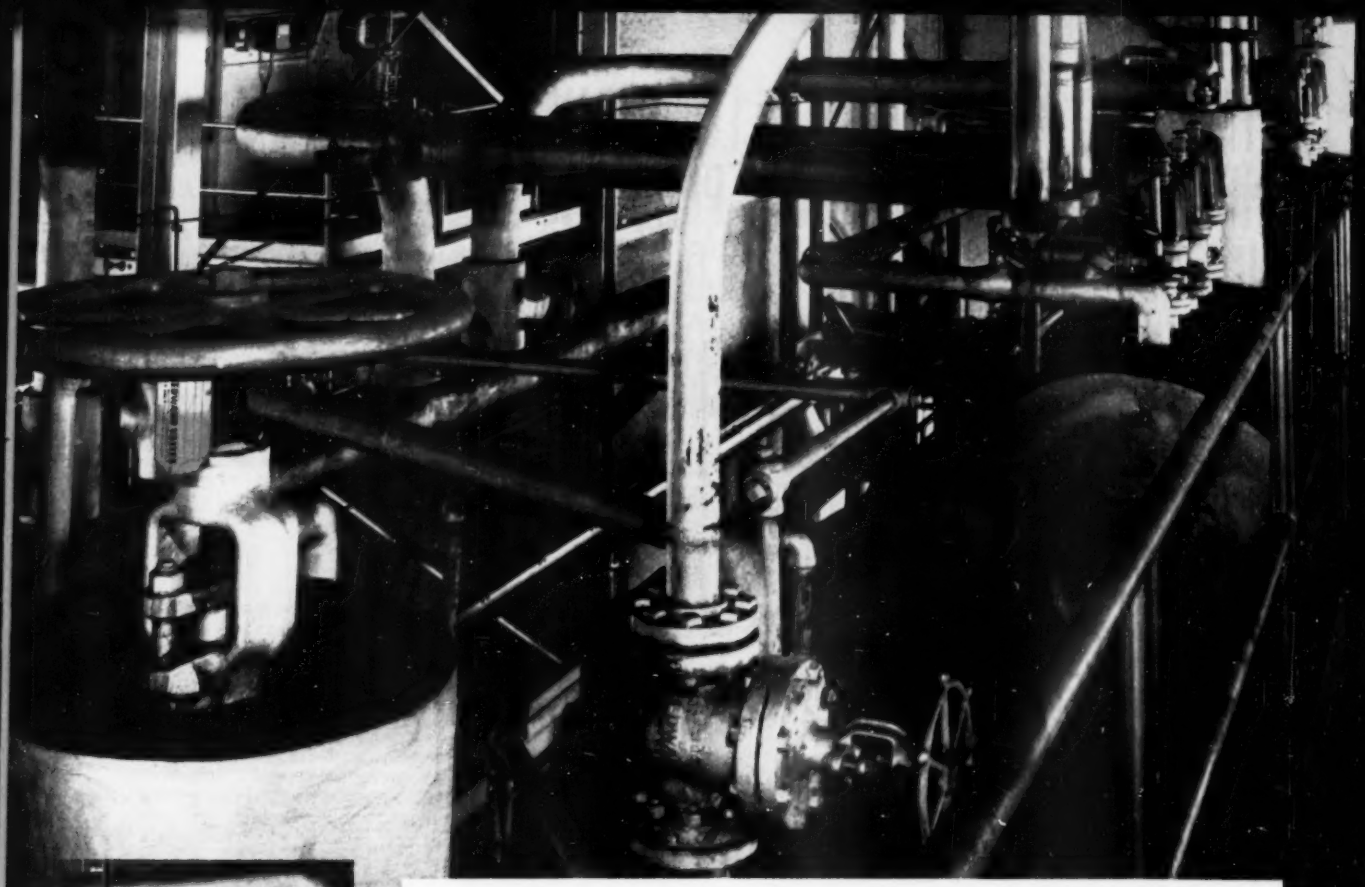
OBVIOUSLY in old installations where little space is available for ducts, high velocity air distribution offers advantages. However, special silences and larger air outlets are required to absorb noise.

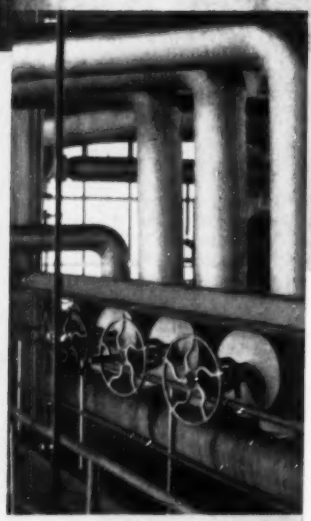
In every air conditioning installation lower air velocities are desirable. Air velocity should not exceed 100–120 fpm when directed at spaces where people are moving around. Offices should be held to a 70 fpm minimum to avoid discomfort.

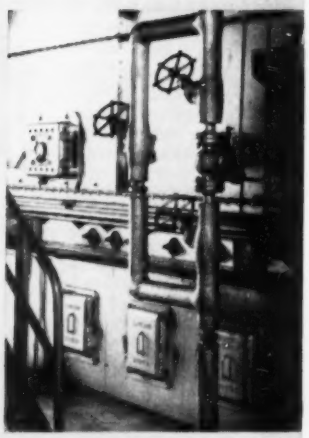
Avoiding drafts require ceiling diffusers with bottom grille dampers. Air velocity can approach 3000 fpm and will be properly diffused with lowered noise in spite of machines, columns and other obstacles. The smaller ducts and simplified layouts save valuable space and initial installation costs. Radio and tv studios require air velocities through necks of air diffusers to be in the neighborhood of 700 fpm for minimum noise.

All air conditioning equipment should be set on shock absorbers which prevent vibrations traveling through ducts. Equipment foundations should be separated from main building foundations. Fan wheels often create turbulent air flows at discharge which can be minimized

"Who in hell ordered a bourbon gage?"







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RAY D. GANGWER, Chief Engineer, Gets Dependability, Saves on Replacements and Repairs with Steel Valves

Buying EDWARD 300 lb sp steel valves for 150 lb sp service proved a good investment at The Dr. Norman M. Beatty Memorial Hospital, Westville, Indiana.

Years ago, labor for repairing or replacing valves was relatively inexpensive. But, today, labor often costs more than the valve. So, for economy, the feedline, non-return, main steam distribution, blow-off and miscellaneous drain, gage and auxiliary valves in this steam generating plant are steel.

Maintenance personnel at the hospital like trouble-free Edward steel valves. Edward's dependability and low maintenance requirements more than justified their slight additional cost over the usual low pressure valves.

You, too, can cut your maintenance expense with low-cost Edward steel valves. Call the nearest Edward representative or contact Edward Valves, Inc., today.

The first of a series of case histories on the use of Edward steel valves in "under 300 lb sp" service.

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Tru-Lay Push-Pull Controls provide POSITIVE REMOTE-ACTION over long or short distances . . . with fixed or movable anchorages . . . for light loads or loads up to 1,000 lbs., and these units are frequently and successfully used in conjunction with Electrical, Hydraulic and Air Controls.

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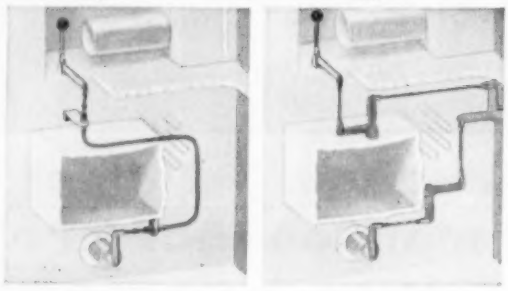

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together with Precision and Long Life, explain why TRU-LAY PUSH-PULLS serve designers and users equally well in improving machine operations, whether the application is on such severe service jobs as Bulldozers, Power Shovels and Steel Mill Machinery, or on such light duty work as Photographic Equipment, X-Ray or Business Machines.

Immunity to Vibration makes these TRU-LAY PUSH-PULLS ideal as Remote Controls on shakers and other vibratory products.

Complete Protection Against Dirt and Moisture is a big factor in the use of this unit on machinery in Coal Mines, Cement and Steel Mills, Oil Fields and in many other industries.

Corrosion-Resistance of the unit, plated or with Stainless Steel construction as required by the use, has led to many applications in the Marine Field . . . salt water or fresh. Supplied with a rubber cover the unit operates effectively even when conduit is COMPLETELY IMMERSED.

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Temperatures as low as −70° F. will not hinder the proper operation of this unit, and it is thoroughly effective even in the extreme high temperatures encountered on Jet Engine, Furnace Door and Glass Furnace Damper control applications.

It is more than likely that you will find ACCO TRU-LAY *Flexible* PUSH-PULL CONTROLS doing a good job on some or many of the products used in your own business . . . on your drinking fountains, business machines, factory lift trucks (gas or electric) to control tilt and lift, or in your power or heating plant, perhaps controlling the pitch of blades on a big exhaust fan. The full list of applications is simply tremendous.

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Questions and Answers

continued from page 102

by adding turning vanes in well-padded duct elbows. Belt drives are preferable for motor-fans, being easier to line up and noise cannot travel from motor to fan.

Branch ducts require hangers for stability and when passing through walls should have insulation at cross-through points to avoid wall noise pickups. Separate ducts for both supply and return, will prevent noise travel from one area to another. Floating construction duct mounting virtually eliminates duct noise. Elbows should be kept from branching too close to fan outlets.

Loose dampers and sharp edges in ducts mean noise. Duct elbows should have ample sweep, or turning vanes should be added to prevent air turbulence and one sided air flow.

Ducts to air diffusers should have an air velocity at least 100 fpm less than corresponding neck velocity. Sound absorbing linings inside ducts and felt linings on dampers reduce noise. This insulation gives added air-conditioning gain. Allowance must be made for acoustic linings in ducts.

High heat loads requiring more than 12 air changes per hour necessitate high capacity air diffusers. Equalizing deflectors in the neck of diffusers will equalize air for quiet distribution. Felt padding vanes and blades of the equalizing dampers absorbs noise. Joints between ducts and air diffusers should be flexible. Diffusers should be mounted tight against duct to prevent air leakage which creates noise.

Sound waves diminish in intensity as they move away from noise source. Air diffusers located at ceiling height will be quieter than one in the wall, even if the wall outlet is one foot below the ceiling.

Jefferson City. L. W. FITZPATRICK

Answer to No. 520

James Gives Velocities

PRACTICE varies considerably, depending on local conditions, but where reasonably quiet operation is essential the following velocities will generally be satisfactory:

In main ducts . . . . . 1000 fpm
In branch ducts . . . 600–800 fpm
In grille or outlet . . . 300–400 fpm

In industrial plants with a relatively high noise level, main duct velocities may be increased to 2000 fpm or as high as 3000 fpm. Pneumatic conveyors may require considerably higher velocities, but apparently J.O. did not have reference to this type service.

Chicago, Ill. ROBERT JAMES

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Standard catalogs listed monthly to help you maintain a reference library

BOILERS, GENERATORS

201 Shop-Assembled Boiler — Sixteen-pp Bulletin G-76, completely describes and illustrates company's Type FM water-tube integral-furnace boiler, made in standard sizes from 2900 to 28,000 lb of steam per hr, pressure to 250 psi. Savings in erection, installation and moving costs are stressed. Capacities, dimensions given. The Babcock & Wilcox Co.

202 Packaged Boilers — This 16-pp illustrated catalog describes manufacturer's new Type VP package boiler. Following a section of background information is an outline of the principal design features of these boilers, which are shop assembled and provide steam capacities from 4000 to 30,000 lb per hour. Space requirements are shown in a table along with typical specifications. Also described is control system. Combustion Engineering, Inc.

203 Steam Boilers — Form AD-100 is an 8-pp catalog providing complete description of company's self-contained boiler, hot water or steam, for heating and processing. Includes design details, capacities, dimensions and application information on boilers ranging from 15 to 500 hp and 15 to 250 psi. Cleaver-Brooks Co.

204 Improved Steam Generator — Bulletin 2000, 28 pp, explains advance design features that distinguish this manufacturer's generator from other unit steam generators. Describes and illustrates engineering differences of component features. Also shows how these components are constructed, assembled and tested. Another section gives data, and dimensions for the units which range from 20 to 6000 hp. Preferred Utilities Mfg. Corp.

It's easy to get these free catalogs—just circle item numbers of those wanted on post card at right. Use the card, also, to ask for further information on the advertised products.

205 Steam Generators — Illustrated Bulletin SB43, 20 pp, describes company's VL factory assembled generators combining 2-drum water-tube boiler, integral water cooled furnace, brick work, insulation and steel casing. A large cut-away illustration shows design details, and gas travel. Erie City Iron Works.

206 Automatic Boilers — This bulletin describes 17 sizes of Powermaster packaged automatic boilers from 15 through 500 hp for steam process, steam and hot water heating service. Lists such advantages as three-pass design, forced

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draft and automatic controls. Describes firing equipment for light and heavy oils, gas; shows various fuel firing arrangements. Orr & Sembower, Inc.

TUBING AND ACCESSORIES

207 Double-Walled Tubing — Technical Bulletin 1950, 12 pp, presents tubing designed for conditions where single-walled tube can't withstand simultaneous attack from two types of corrosive media. Describes and illustrates construction, illustrating possible metal combinations. Explains tubing's use in ammonia refrigeration, boilers, steam generators. Discusses heat transfer properties, high temperature use. Bridgeport Brass Co.

208 Condenser Tubes — Excellent information on condenser tubes and their service life is given in this 40-pp illustrated booklet. Subjects discussed include corrosion of condenser and heat exchanger tubes, corrosion resistance and control, the selection of tube materials, and the composition and physical properties of company's alloys. Details on proper installation are given. Scovill Mfg. Co.

209 Life Extension for Condenser Tubes — This 32-pp extensively illustrated booklet reports on research into the causes of corrosion and means of combating them, as well as the choice of condenser tube materials. Points out that Admiralty metal, long a standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be necessary in some circumstances. Revere Copper and Brass, Inc.

210 Nickel Pipe and Tubes — Bulletin T-17 is a 27-pp technical bulletin on the fabrication and design of nickel and high nickel alloy pipe and tubing, illustrated throughout by drawings and photos. Presents tables on mechanical and physical properties, ASME code requirements, recommended welding procedures. The International Nickel Co., Inc.

211 Tube Cleaners — Catalog 76-A provides 48-pp of information on manufacturer's line of tube cleaners. Following equipment selection and operating hints, this practical catalog describes and pictures cutter heads and drill heads, brushes, and motors, giving sizes, application information. Electrically driven equipment, air valves, hose, lubricators presented. Thomas C. Wilson, Inc.

212 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads discussing special features. Roto Div., Elliott Co.

213 Data on Stress Values — Data Card 154 is designed to help power engineers concerned with the operation of tubular equipment at elevated temperatures and pressures. The card is an adaptation of Table P-7 of the new ASME Boiler Code and is complete with notes and formulas for calculating maximum allowable working pressures. Tubular Products Division, The Babcock & Wilcox Co.

BURNING EQUIPMENT

214 Automatic Burner — Bulletin 420 contains approximately 30 pp of engineering data on a new burner unit for gas, oil or combination firing and sized for capacities to 42,000 lb of steam per hour. Separate sections of this looseleaf manual

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The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

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Megger® Ground Tester measures low resistance

Photo Courtesy Copperweld Co.

In spite of apparently good lightning rod or arrester protection, lightning frequently will cause severe damage if high ground resistance hampers its dissipation in the earth. Lightning storms are prevalent in the northeastern states during the spring and fall months. Plants in this section should make a thorough round of ground resistance tests. Aside from the hazards to personnel, thousands of dollars may be saved in damage to electrical equipment and in loss of power and stoppage of production.

The MEGGER Ground Tester is the easiest, quickest and most accurate method of determining ground resistance. It is an instrument specially designed for the purpose and should be used wherever possible. Direct readings are automatically obtained in ohms. It provides its own source of current—no batteries, or other remote source required. It's easy to carry, too. Has approval of the Associated Factory Mutual Insurance Companies.

Don't put it off—write today for "Grounding Electrical Circuits Effectively" by J. R. Eaton **(Bulletin 25T2-PE)** and our Biddle manual on "Ground Resistance Testing" **(Bulletin 25J-PE).**

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are devoted to photos and discussion of special features of the burner, general specifications, parts list, wiring and piping diagrams, explanation of operating sequence, and performance data. Available to qualified power engineers, please state your job title when requesting this bulletin. Peabody Engineering Corp.

215 Oil and Gas Burners — Bulletin OB-53, 28 pp, gives principles of selection and application of oil or gas burners, or a combination of both for standard and wide capacity range operation, together with air registers and fuel oil heating and pumping sets. Conversion table shows approximate relationships between quantity of oil burned, boiler capacity and air required for combustion. Specifications included. The Engineer Co.

216 Steam Atomizing Oil Burners — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces, where steam or compressed air is available for atomizing the oil. National Airoil Burner Co., Inc.

FUEL OILS, LUBRICANTS

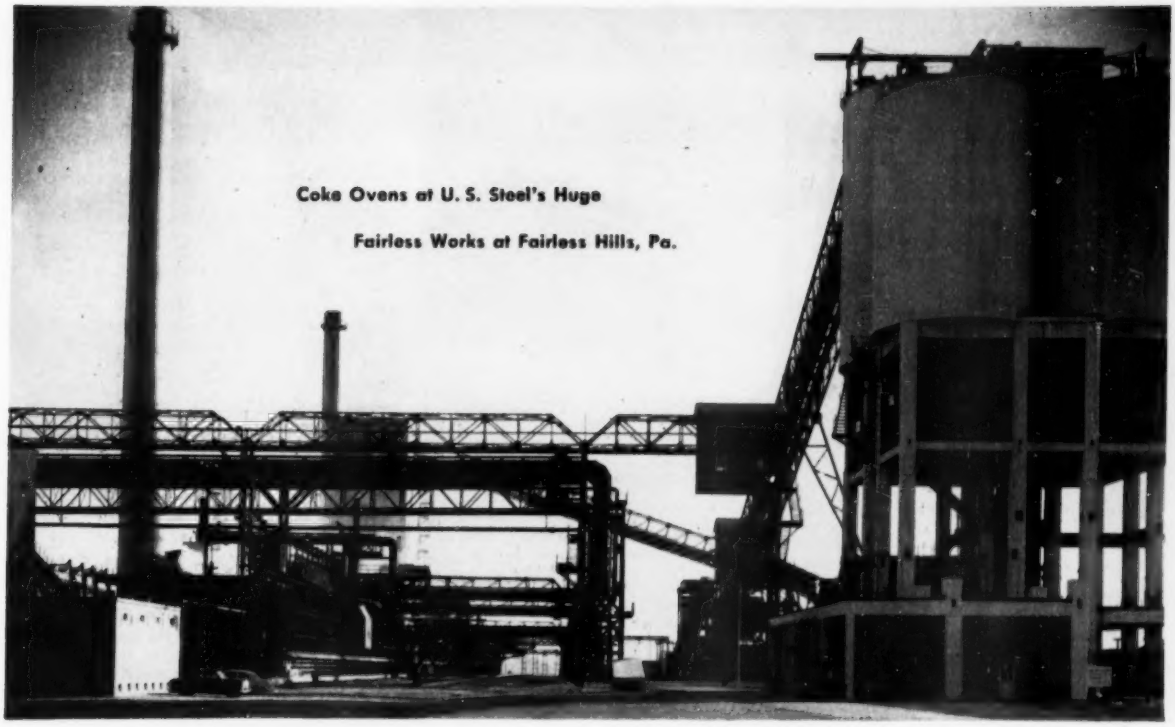
217 Air Compressor Lubrication Manual — Valuable information on air compressor maintenance is contained in this 40-pp book. Subjects treated include compressed air, compressors and related equipment, lubricating systems, compressor oils and applications, lubrication requirements, operating hints, oil requirements, storage and care of compressor oils, also safety precautions. Cities Service Petroleum, Inc.

218 Diesels, Their Fuels and Lubricants — This 46-pp book gives practical information on diesel engines, covering their history and economics as well as design characteristics and operating principles. Classification of diesels according to speed is covered. Sinclair Refining Co.

219 Versatile Industrial Oil — Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and available in 15 viscosity grades. Discusses six major characteristics of the oil; explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors, hydraulic turbines, bearing systems, etc. A chart shows grades available, their uses and physical properties. Standard Oil Co. (Ind.)

220 Turbine Lubrication — The special problems of turbine lubrication are discussed in 8-pp Bulletin TU-1. Tells how purifiers keep power units in service; discusses inhibited and uninhibited oils, company's process for reducing sludge formation within lubrication system. Illustrated with diagrams of typical installations, photos of purifiers. DeLaval Separator Co.

221 Compressor Lubrication Problems — Vol. 40, No. 1 of Lubrication provides a 14-pp article on problems associated with compressor lubrication. Reviews compressor types, function of the lubricant and importance of adequate installation. Air compressor explosions and receiver fires are discussed, as are condensation and compressor cooling, bearing lubrication, selection of lubrications. Special problems of air, gas, refrigerator, and other compressors are treated. Includes lists of factors which control dependable



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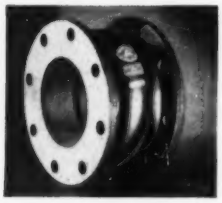

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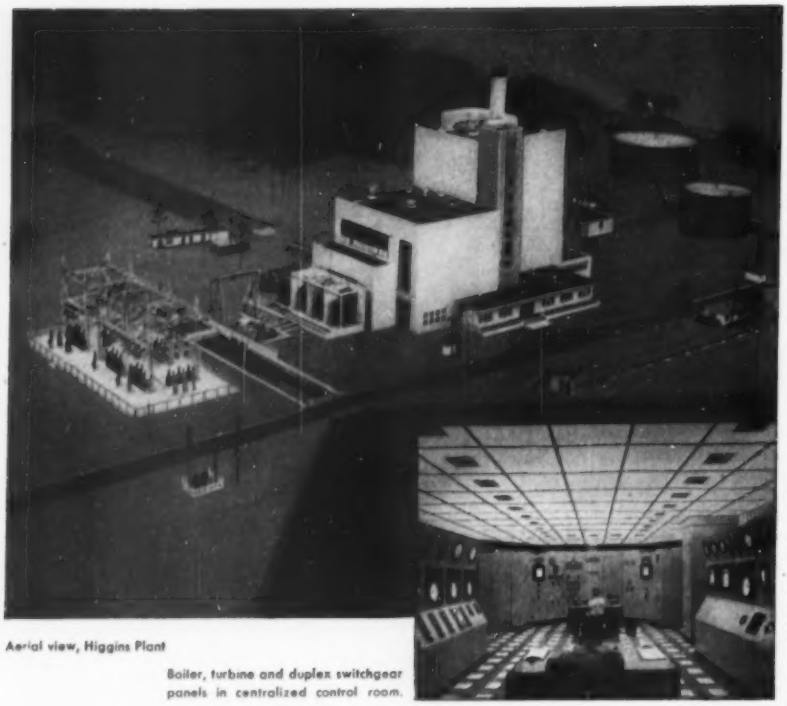

Aerial view, Higgins Plant

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compressor operation; those which may react against efficiency. The Texas Co.

222 Cooperative Technical Consultation Service — This informative 24-pp booklet presents company's periodic consultation service aimed at the most efficient use of petroleum products. Covers services available in the solution of lubrication problems, metalworking operations, processing, fuel oils, dust control. Gulf Oil Corp., Gulf Refining Co.

223 Petroleum Pitch — This illustrated article on petroleum pitch as a boiler fuel stresses its low cost, other advantages. Explains combustion of pitch; discusses unloading method, burning, storage, fuel oil treatment, also precautions in handling hot pitch. Kor Corp.

224 Turbine Oil Conditioning — Bulletin 832-P, 12 pp, offers a detailed explanation of the reasons for turbine oil conditioning, the way in which company's dry type conditioning equipment nullifies or prevents factors which promote deterioration of oil. Bowser, Inc.

VALVES, TRAPS, PIPING AND ACCESSORIES

225 Check Valves — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principle of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes. The Chapman Valve Mfg. Co.

226 Safety Valve Engineering Data — How company's safety valve works and its operating advantages are explained in Bulletin 707. Includes dimensions on valve types, also provides tables on superheat correction factor. Manning, Maxwell & Moore, Inc.

227 Solenoid Operated Valve — Eight-pp Technical Bulletin W-7 describes solenoid operated valves which automatically open or close in response to time clock, pressure switch, manual switch or other impulse. Contains operating instructions, illustrated parts lists, and dimensions for these valves, used in steel, processing, pulp and paper mills, rubber and chemical plants, and water works. Golden-Anderson Valve Specialty Co.

228 General Service Valves — Bulletin E-160, 16 pp, describes and illustrates design and construction of company's quick operating valves, explaining their application to blow-off service and on chemical process, soot blowers, water column blow-down, and other types of pipe line. Everlasting Valve Co.

229 For Quick Valve Selection — Here's a 20-pp catalog digest providing ordering and application information on gate, globe, angle and check valves in bronze, iron, cast and forged steel construction, also valve accessories and parts. Illustrated and indexed, includes pressure-temperature chart. The Ohio Injector Co.

230 Butterfly-Valves — Construction details, engineering and application data on butterfly valves are provided in three illustrated bulletins. Eight-pp Bulletin 557 covers those of standard heavy-duty construction; Bulletin 558, 8 pp, those of standard medium-duty construction; and Bulletin 559, rubber-lined butterfly valves. W. S. Rockwell Co.

4 GOOD REASONS for specifying Watson-Stillman Forged Steel Fittings

Here's why **W-S FORGED STEEL FITTINGS** mean safe, dependable operation of your piping system:

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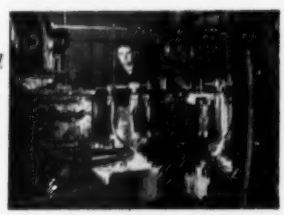

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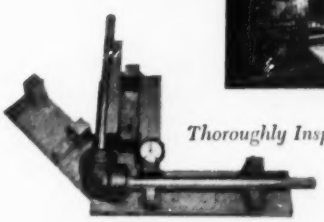

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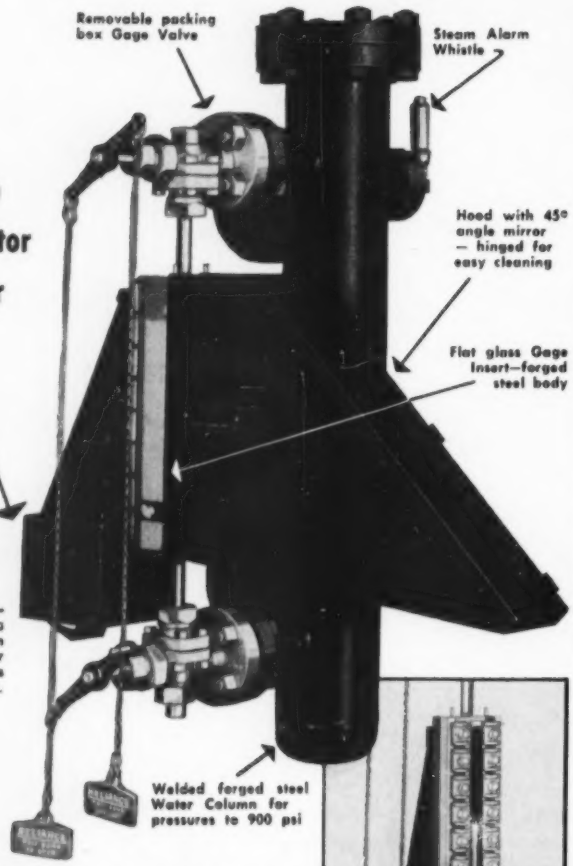
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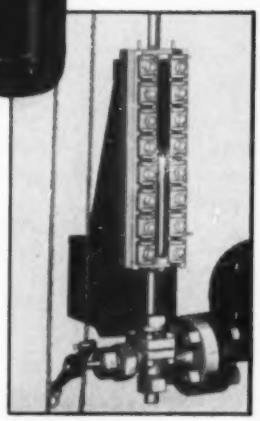
Recommended for conditions where gages are 40 ft. or more from operating level, or for extra bright meniscus image. See cut at right.



Reliance Water Columns for any working steam pressure assure you the utmost in dependability. High and low water level alarms are available on columns for pressures to 900 psi. Standard and special columns and complete safety gage equipment are made for pressures to 2500 psi.

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231 **Valve Specialties** — Included in 90-pp Catalog A-50 is ordering and engineering information on automatic pressure flow and liquid level controls for steam, air, gas, water, oil, other fluids. Sections are devoted to pressure regulators, altitude valve, pump governors and strainers; lever, float and motor operated valves; pilot valves; back pressure, relief and non-return valves, steam trap and air vent; liquid level controllers; solenoid valves. Davis Regulator Co.

232 **Regulating Valves** — Bulletin 313 describes double seated diaphragm regulating valves for use with control instruments, outlining special features of the valves, particularly the "flow line" contoured body engineered for high capacity at low pressure drop. Leslie Co.

233 **Pump Valves** — Sixteen-pp Catalog SC-510, now available to power engineers, describes and illustrates valves made to fit practically all makes of reciprocating pumps. Key features of the valves are discussed, and standard, lock-in and deck types are covered in detail. Sims Pump Valve Co., Inc.

234 **Cast Steel Valves** — This 56-pp catalog on cast steel valves includes information on globe, angle and check valves in 300, 600, 900 and 1500 lb pressure classes. Parabolic disc valves for hand or motor control of volume are also described. In addition to standard information on construction features, dimensions and weights, the booklet contains complete data on material specifications, preparation of welding ends, flange facings, and ratings. Edward Valves, Inc.

235 **Lubricated Plug Valves** — Revised Catalog PV-2, 12 pp, presents steel and semi-steel valves designed to offer quick shut-off of erosive or corrosive fluids. Explains advantages of the lubricated tapered plug design of these valves and pictures single gland, screwed gland, and bolted gland types. Also shows accessories. The William Powell Co.

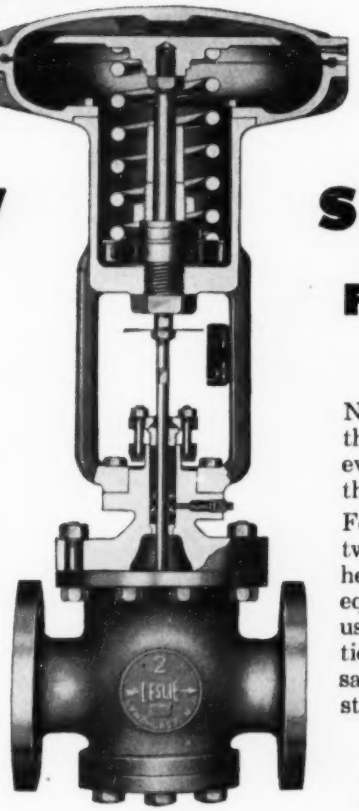
Postage-free cards for ordering catalogs are on pages 105-106. You may also use the cards to ask for further information on the advertised products.

236 **To Get at Those Valves** — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all valve wheels. Babbitt Steam Specialty Co.

237 **For Precise Control** — Fifty-pp Catalog 17 covers manufacturer's line of disc valves and accessories, providing full selection and ordering data, materials of construction, sizes. Describes manuals and automatic controls for these valves which, it is noted, are available in any metal which can be cast or welded. Minimum pressure drop, quick closure, simplicity and other advantages are discussed. R. S. Valve Div., S. Morgan Smith Co.

238 **Solving Steam Trap Problems** — This 36-pp catalog on steam traps contains specifications and capacities on steam traps, float traps, air release valves and pipe line strainers. Tells how to calculate condensation loads and select traps for all classes of equipment, including unit heat-

something **SPECIAL** in a **STANDARD** control valve...



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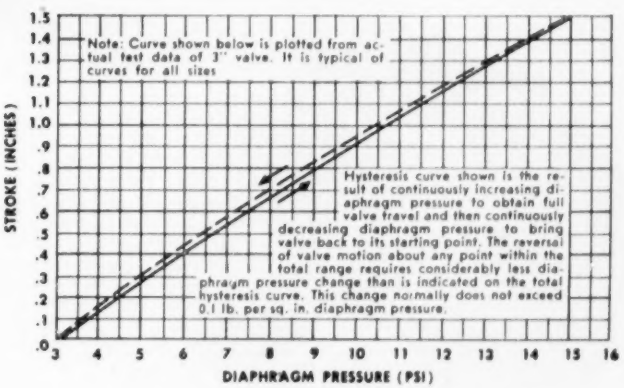
Now standard for *all* Leslie Diaphragm Control Valves, this new rugged, precision stroke, superstructure means even more reliable performance than the high level set in the past by Leslie.

For instance, linearity (the straight line relationship between diaphragm pressure and inner valve movement) is held to plus or minus 2% for valve strokes up to 1½"—equivalent to .020" for valves with 1" stroke without using valve positioner. Hysteresis, the difference in position of the inner valve on the up and down strokes for the same diaphragm pressure, is held to 2% of full valve stroke for travel up to 1½". Here is the curve.


Note: Curve shown below is plotted from actual test data of 3" valve. It is typical of curves for all sizes
Hysteresis curve shown is the result of continuously increasing diaphragm pressure to obtain full valve travel and then continuously decreasing diaphragm pressure to bring valve back to its starting point. The reversal of valve motion about any point within the total range requires considerably less diaphragm pressure change than is indicated on the total hysteresis curve. This change normally does not exceed 0.1 lb. per sq. in. diaphragm pressure.
STROKE (INCHES)
1.5 1.4 1.3 1.2 1.1 1.0 .9 .8 .7 .6 .5 .4 .3 .2 .1 .0
3 4 5 6 7 8 9 10 11 12 13 14 15 16
DIAPHRAGM PRESSURE (PSI)

Only Leslie gives you all of these "made-to-order" advantages in a standard valve.

- ✔ Full-flow, smoothly contoured body
- ✔ Renewable, interchangeable seat rings
- ✔ Bolted stuffing box
- ✔ Molded rings or Teflon packing
- ✔ Thermo-isolating bonnet
- ✔ Accurate part replacement from name plate data
- ✔ Stem flats for ease of connection

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Bulletin 5305 (Double Seated Diaphragm Control Valves)

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REGULATORS SINCE 1900
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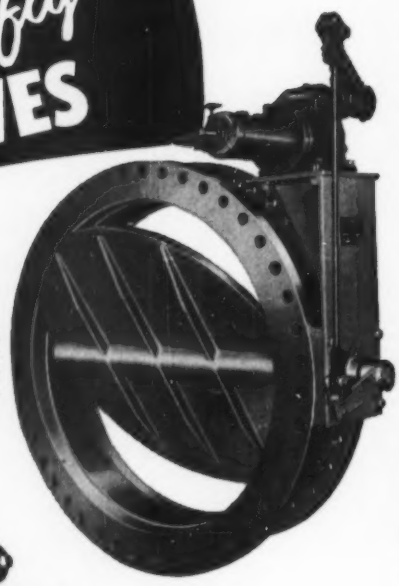

A 54" cast iron butterfly valve with stainless steel blade for low pressure air; equipped with crank type cylinder operator; installed in public utility plant.

Three-way valve made with 24" and 14" butterfly valves mounted on a "tee"; linked so as to close one valve when the other opens; operated by spring-loaded hydraulic cylinder; for air and exhaust gazes to 60 p.s.i. and 350° F.

Rockwell Butterfly Valves are made of any required metal or rubber-lined for minimum pressure drop, uniform, quick control and positive shut-off—commercial, drip or air-tight. Sizes to 132"; pressures to 900 p.s.i.; temperatures to 2000° F., in standard and special types. Catalog on request.

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ers, jacketed kettles, autoclaves, submerged surfaces, steam mains and header drips. Gives pointers on how to install and service traps. The V. D. Anderson Co.

239 Steam Trap Book — Catalog J, 44 pp, serves as a manual of trapping practice. Includes a catalog section giving physical data and prices on cast semi-steel and forged steel inverted bucket steam traps, compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment; a maintenance section explaining trap installation, trouble-shooting and repair. Armstrong Machine Works.

240 Steam Trap Reference Manual — Bulletin T-1740, 24 pp, tells why and where steam traps should be used; explains desirable trap features. Advantages of company's impulse steam traps are described, their operation illustrated. How to figure trap sizes and how to size condensate return lines are told and capacity and pipe dimension charts and thermodynamic properties of saturated steam included. Yarnall-Waring.

241 Industrial Steam Traps — Twelve-pp Bulletin 853 describes steam traps with bellows of bronze, Monel or stainless steel, and bodies in bronze, semi-steel and cast steel construction in sizes ¼ to 2 in., for pressures from vacuum to 300 lb. Included besides capacity tables and dimensions are piping diagrams, typical applications, and data covering the selection. W. H. Nicholson & Co.

242 Piping Pointers — This is company's highly popular 36-pp manual covering fundamentals of sound piping practices. Discusses various types of valve designs and how each should be used. Pictures and names more than 80 fittings and contains illustrated how-to-do-it features. Includes 8-pp valve selection guide. Crane Co.

243 Unions and Fittings — Twelve-pp Catalog 50 covers manufacturer's line of unions of all types, elbows, tees and fittings. It describes and illustrates special features. Dart Union Co.

244 Handbook on Fittings, Flanges — Catalog wf-1950, 68 pp, offers working information on seamless carbon steel welding fittings and forged steel flanges. Includes dimensional tolerances, thread standards and threading practice; service pressure ratings, physical and chemical requirements. Grinnell Co., Inc.

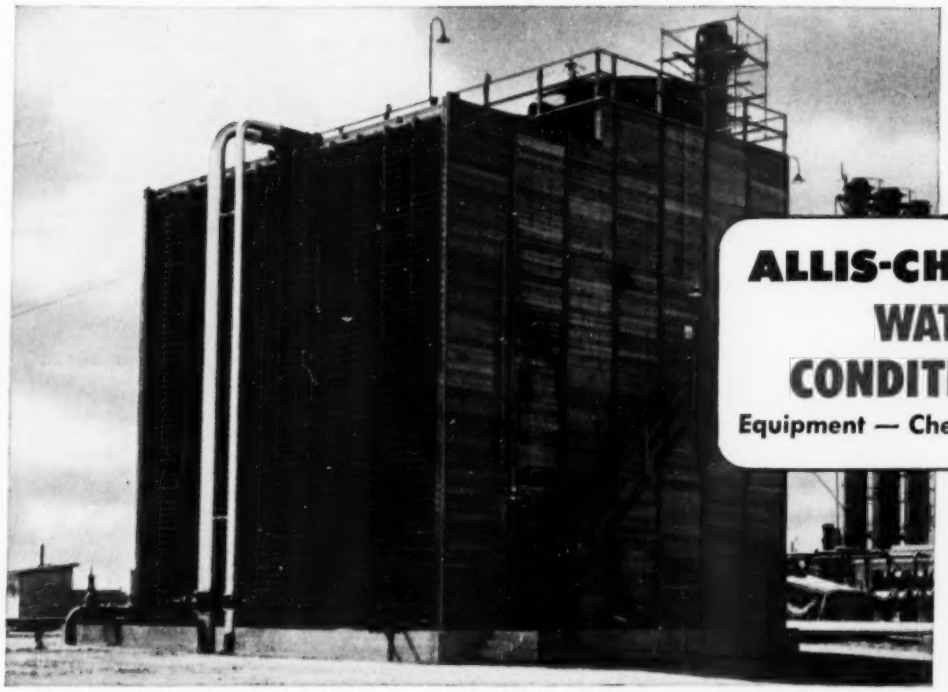
245 Improved Pipe Hanger — Twelve-pp Bulletin 153 describes company's Counterpoise pipe hanger for high temperature piping systems in steam generating stations, refineries and chemical plants. Tells how it offers efficient load supporting effort of constant value throughout entire range of travel as pipe expands or contracts because of temperature changes. Graphs for selecting proper hangers, tables of dimensions, plus erection are given. National Valve & Mfg. Co.

247 Forged Fittings — Literature is available on screw-end and socket-weld fittings. Stresses economy and other advantages of these fittings, lists steels available. Watson-Stillman.

PUMPS, PUMPING

248 Condensed Pump Data — Form 4383-J covers more than 20 types

SOLVING WATER PROBLEMS in Cooling Towers



Use of cooling towers to save on water brings unusual problems. Some of these problems are corrosion, scaling, algae and slime, and deterioration of wood in the tower. Allis-Chalmers recently published an informational bulletin, Number 47A, which explains the causes of these problems and what can be done about them.

Part of Practical Library

This bulletin is one of a series published by Allis-Chalmers to help you understand the causes and solutions of many water problems. It is the result of Allis-Chalmers experience solving water problems for every industry, in addition to solving problems involved in the company's own broad line of steam turbine and power plant equipment.

Complete Water Conditioning Service

Allis-Chalmers offers complete water conditioning service. You can get analyses and reports on your problems. You can get chemicals needed in water treatment. And you can get the equipment needed for any system.

A-4316

Get Information — For your copy of Bulletin 47A on water treatment for cooling towers, write Allis-Chalmers, Milwaukee 1, Wisconsin. Or better, call your nearby A-C district office to have an Allis-Chalmers water conditioning engineer consult with you on your problems.

ALLIS-CHALMERS

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There's new thinking in power houses—and practically any other plant area you can name. New ideas in interior planning, new uses of color, and *new thinking in communication.*

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The completely integrated sound system in this modern plant provides complete two-way communication at all these key locations: power supervisor's office . . . control room . . . turbine room . . . load dispatcher's office . . . basement and auxiliary apparatus room . . . fan and regulator room . . . and outdoor stations.

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of general service pumps, rotary pumps, sump and drainage pumps, condensate units, self-priming units, stainless steel pumps and high pressure pumps. In easy-to-find tabular form, each model is pictured along with its characteristics, applications, features and references to specific literature available on each of them. Goulds Pumps, Inc.

249 Boiler Feed Pump — A barrel-type boiler feed pump for high pressure, high temperature service and designed to go on the line quickly without preliminary warm-up is the subject of 12-pp Bulletin 1525. Fully illustrated text explains automatic operation of hydraulic thrust balance incorporated in this pump. De Laval Steam Turbine Co.

251 Gear Pumps — Besides presenting all of company's standard gear pumps, 24-pp Bulletin 17-A describes briefly some special types engineered for unusual requirements. Discusses design, construction and operation of the pumps; tells how they're used in the power and industrial fields. Drawings, action photos, capacity and pressure tables and performance data supplement the text. Booklet covers pumps ranging from 1 gph to 1000 gpm capacities. Schutte and Koerting Co.

252 Controlled Volume Pumps — Motor-driven controlled volume pumps are fully described in 40-pp Bulletin 553. Provides information on design and construction of the pumps, and includes capacity-pressure selection tables, types of capacity adjustments, standard and special designs and packaged systems. A chart shows typical applications in six major industries, and another chart, in full color, shows construction materials suited for use with some 170 industrial fluids. Milton Roy Co.

PACKINGS, SEALS

253 Packings and Gaskets — Catalog P-100C, 32 pp, covers 95 most popular packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing specific recommendations for many applications. Packing Div., Raybestos-Manhattan, Inc.

254 Seals for Bearings — Complete information on manufacturer's Klozure oil and grease seals for bearings is available in 100-pp Catalog 10. Fully illustrated in color, pictures all types of these seals, typical applications and lists sizes and part numbers. Also describes mechanical pressure seals for rotary shafts. The Garlock Packing Co.

COAL, ASH HANDLING

255 Spreader Stoker Data — This is a file of three illustrated bulletins on spreader stokers. The first discusses seven reasons for selecting these stokers and describes their design, construction and operation; the second, dumping grates, the third, installations. Riley Stoker Corp.

257 Spreader Stoker Selection — Fourteen-pp Form F-520-A10M is intended to help those choosing a spreader stoker to get the most for their investment, and it points out many factors to be considered. American Engineering Co.

258 Economic Coal Storage — How tractors establish safe, orderly coal handling is told in this 8-pp booklet. Stresses flexibility, low operating costs. Also shows how tractors speed storage reclamation

Companions IN RELIABLE SERVICE...

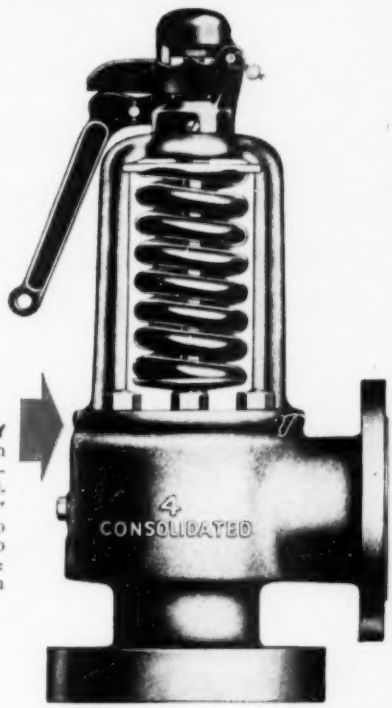
TYPES 1411 and 1415 CONSOLIDATED SAFETY VALVES

TYPE 1411

CAST IRON BODY SAFETY VALVE. Has bevel seat, single ring blow-down control and one-piece feather (disc). **Sizes:** 1½" through 6". **Pressures:** Up to 250 psi. **Temperatures:** Up to 450° F. **Standard Connections:** Threaded or flanged. All sizes available with oversize inlet flanges for replacement purposes.

TYPE 1415

CAST STEEL BODY SAFETY VALVE. Has a high erosion and corrosion-resistant stainless steel seat bushing **seal-welded to the base. Sizes:** ½" through 6". **Pressures:** Up to 900 psi. **Temperatures:** Up to 900° F. **Standard Connections:** Flanged. Available with oversize inlet flanges.



Dependable performance in hundreds of installations is the history of Consolidated Safety Valves Types 1411 and 1415. Time and time again, the high discharge capacity of these rugged valves has been thoroughly proved in the field. Positive, tight closing after operation is assured. Both types are simply constructed spring-loaded, wing-guided valves with few working parts. Adjustment is easy; maintenance economical.

Type 1411, with cast iron body, is excellent for installation on water tube boilers, mechanically-fired fire tube boilers, accumulators, unfired pressure vessels and pipe lines within its rated capacity. Types 1415, with cast steel body, is recommended for all applications beyond the scope of companion valve Type 1411.

Protect your personnel, facilities and production against the hazards of overpressures. Install precision-built Consolidated Safety Valves. Selection is easy. Write for Catalog 700.

CONSOLIDATED SAFETY VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONN.

MAKERS OF 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' AND 'AMERICAN-MICROSEN' INDUSTRIAL INSTRUMENTS, 'ASHCROFT' GAUGES, 'HANCOCK' VALVES, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

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For experienced counsel and personal attention to water or steam problems at your plant, it will pay you to call on Bird-Archer's qualified engineers. Highest quality chemicals and over sixty years experience assure maximum results with Bird-Archer's Complete Water Treatment Service.

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Studies of your use of water or steam equipment and past performance.

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Specification and furnishing of additional equipment when necessary, including complete analysis of savings and benefits made possible.

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BIRD-ARCHER COMPANY OF CALIFORNIA, San Francisco

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and how a tractor-scraper combination offers plus benefits. Illustrated with action photos; pictures several models. Tractor Div., Allis-Chalmers Mfg. Co.

259 Automatic Coal Scale — Sixteen-pp Bulletin 0352 describes an automatic coal scale for weighing coal as it is fed to boilers, enabling a power engineer to maintain a constant check on boiler efficiency. Book gives construction and operating details on the belt feeder, weigh hopper, scale housing, operating levers and accessories. Photos and line drawings show scale features. Richardson Scale Co.

260 Why Liquid Diffusion — What liquid diffusion can do for power plants is explained in Form B, which tells how liquid diffusion compounds work and gives four practical applications. These include dust control in coal handling, fly-ash control, coal storage pile treatment and boiler cleaning. Johnson-March Corp.

261 Ash Handling Systems — This 24-pp booklet offers technical information on hydraulic and pneumatic ash and fly-ash handling systems. Compiled in question and answer form. Discusses elements and advantages of various systems and disposal schemes. Schematic drawings of arrangements under specific conditions are also included. Beaumont Birch Co.

262 Fly Ash Collection — The successful and economical separation of fly ash from boiler flue gases is discussed in 28-pp Catalog G405. Explains need for collection equipment and gives physical characteristics of fly ash. Describes company's Multiclone equipment as to principle of operation, performance and advantages. Also describes CMP units which combine in a single installation the advantages of the Multiclone cyclonic tube with the Cottrell electrostatic precipitator. Western Precipitation Corp.

263 Shredder Ring Crusher — A crusher for coal and similar materials which features rolling shredder rings is described in this 8-pp bulletin. Gives details on a survey of 29 mines and power plants in which this type crusher is installed. Informative tables giving speed, capacity, horsepower, weight and dimensions of crushers, as well as cost data are included. American Pulverizer Co.

ELECTRICAL

264 Motor-Generator Reference Book — Publication 51R7933 is a 50-pp booklet compiled to assist in the selection of motive power to handle most industrial applications. Neither text book nor ordering catalog, this book provides a brief outline of the various types of motors, generators and motor-generator sets, telling their applications and operating requirements. Booklet is generously illustrated and includes performance data, ratings, information on methods of speed control, general characteristics and dimensions. Allis-Chalmers Mfg. Co.

265 Electrical Maintenance Tips — Booklet B-5477, 28 pp, gives a complete outline of preventive electrical maintenance. Discusses general maintenance programs designed to reduce shutdown time and treats in detail the maintenance of power equipment. A suggested schedule of work and cleaning on power equipment is presented in chart form. Essential information on preventive maintenance for turbines, generators, switchboards, motors is given. Westinghouse Electric Corp.

you get

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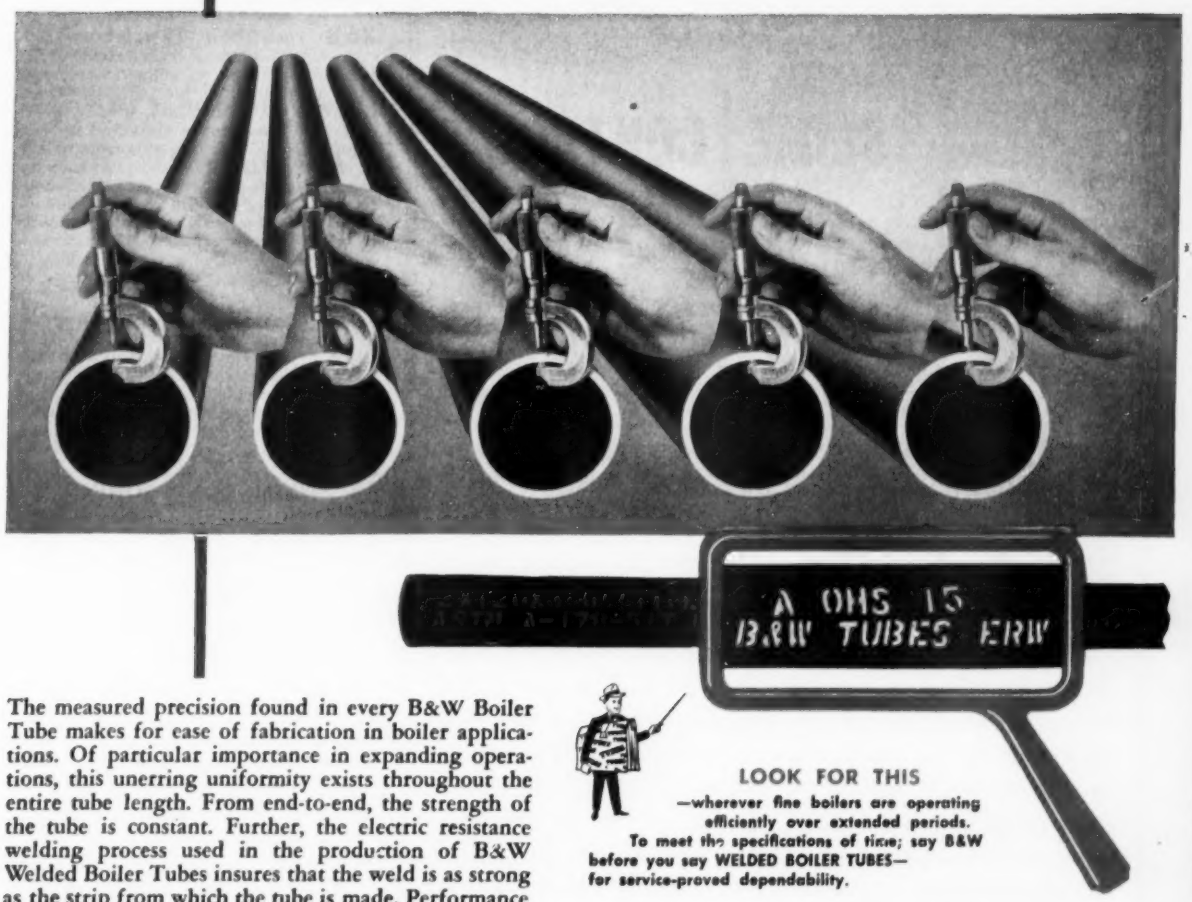
with B&W *Welded Boiler Tubes*



The measured precision found in every B&W Boiler Tube makes for ease of fabrication in boiler applications. Of particular importance in expanding operations, this unerring uniformity exists throughout the entire tube length. From end-to-end, the strength of the tube is constant. Further, the electric resistance welding process used in the production of B&W Welded Boiler Tubes insures that the weld is as strong as the strip from which the tube is made. Performance in service, the true test for any product, has proven that B&W ERW Boiler Tubes pay their way . . . longer and with an evenness of operation that means long-run savings for you.

For three quarters of a century, B&W has been directly concerned with developing and applying boiler tubes for all pressures up to those approaching 3000 psi. The application of this extensive knowledge and experience results, naturally, in the production of finer welded boiler tubes.

For ease of fabrication and long service life specify B&W ERW Boiler Tubes for the tubing in your boilers.

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—wherever fine boilers are operating efficiently over extended periods.

To meet the specifications of time; say B&W before you say WELDED BOILER TUBES— for service-proved dependability.

B&W SEAMLESS and WELDED TUBES

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THE BABCOCK & WILCOX COMPANY

TUBULAR PRODUCTS DIVISION

Beaver Falls, Pa.—Seamless Tubing; Welded Stainless Steel Tubing

Alliance, Ohio—Welded Carbon Steel Tubing

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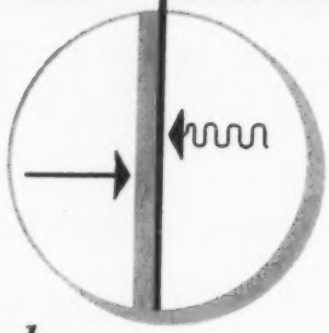
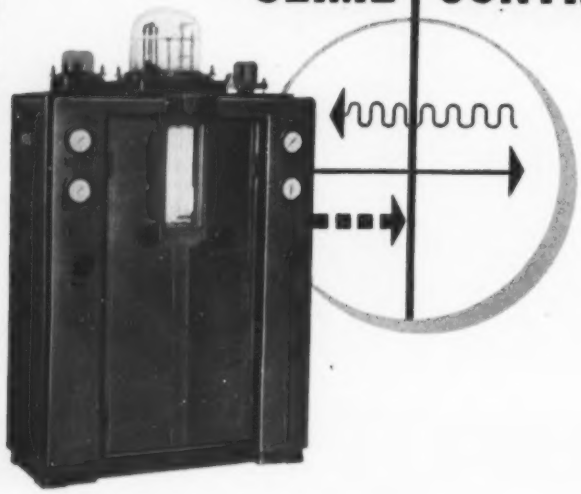
Where you need

HEAT | EXCHANGE



Be sure you have

SLIME | CONTROL



Whether you heat or cool water for make-up, process or any other use, you will need Wallace & Tiernan Chlorination to help combat slime problems introduced by water-borne bacteria or air-borne bacteria.

With slime control equipment designed for any need, built for lasting and dependable service, highly accurate and backed by over 40 years of successful application experience, Wallace & Tiernan Chlorination can help you increase the efficiency of your plant and cut operating costs. For further information write our Industrial Division.

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CD-39

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266 **Wire, Cable Ordering Guide** — Newly-released General Catalog W-52-3, 186 pp, presents more than 500 different types of wires and cables. Contains comprehensive data on construction and operating characteristics for control and signal cables, cables for construction work, telephone wire and cables, and portable cords. A technical engineering data section is included. Available to qualified power engineers. United States Rubber Co.

267 **Power Distribution Practices** — The 28-pp "Industrial Power Distribution Idea Book" (Bulletin GEA 5900) is a guide on electric power distribution practices in large and small plants. Covers utility distribution practices; methods of buying electric power; what to do when a choice of primary voltages is available; application of primary switches and circuit breakers; types and arrangements of primary cables; and types of load-center distribution systems. General Electric Co.

268 **Insulation Temperature-Resistance** — Technical Publication 21T4, 16 pp, is an article on temperature-resistance characteristics of electrical insulation. Complete with tables and graphs, gives general information on variations in temperature characteristics composite nature of electrical insulation, and practicability of temperature compensation. Other chapters deal with determining insulation constants for temperature correction factors, dielectric absorption characteristics, and a practical method of obtaining insulation temperature. James G. Biddle Co.

269 **The Answers on Wiring** — "20 Questions and 20 Answers on Safety m.i. Wiring" describes and illustrates characteristics and advantages of this new wiring system. A complete table of types, sizes, weights and lengths, as well as a partial list of users included. General Cable Corp.

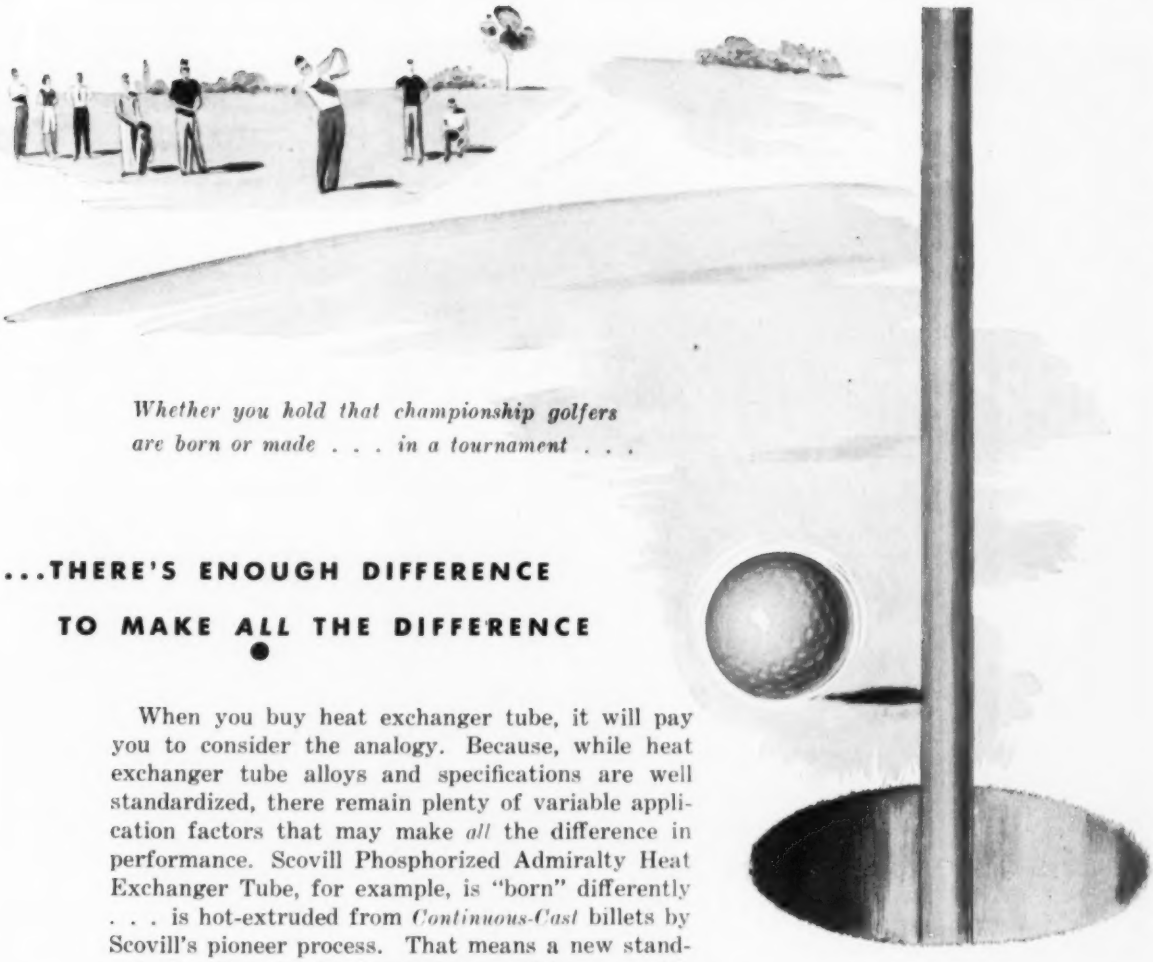
WATER CONDITIONING

270 **Handbook on Demineralizing** — Bulletin 5800, 39 pp, on treating water by demineralizing, explains principle of ion exchange. Discusses applications of many anion and cation exchange materials; series of curves help estimate cost of operation. Describes design and operation of demineralizer systems, multi-stage systems and mixed bed units. Includes curves of water quality obtainable. Cochrane Corp.

271 **Modern pH and Chlorine Control** — This 100-pp booklet gives details in color comparators and equipment in water testing and control of boiler and industrial process water, also technical information on meaning of pH control, electrometric and colorimetric methods of determining pH and impurities in water; applications of water control in air conditioning; feedwater. W. A. Taylor & Co.

272 **Water Conditioning Data Book** — This pocket-size 116-pp booklet presents 77 tables, all valuable to the power engineer. Covers such subjects as hydraulics, impurities in water, boiler feedwater make-up requirements, chemical conversions and chemical reactions. Contains excellent reference information on many phases and methods of water treatment. Available without charge to qualified power engineers. The Permutit Co.

273 **What's What on Ion Exchangers** — Here are three booklets on ion exchangers: Nalcite HCR, a styrene type



Whether you hold that championship golfers are born or made . . . in a tournament . . .

. . . THERE'S ENOUGH DIFFERENCE TO MAKE *ALL* THE DIFFERENCE

When you buy heat exchanger tube, it will pay you to consider the analogy. Because, while heat exchanger tube alloys and specifications are well standardized, there remain plenty of variable application factors that may make *all* the difference in performance. Scovill Phosphorized Admiralty Heat Exchanger Tube, for example, is "born" differently . . . is hot-extruded from *Continuous-Cast* billets by Scovill's pioneer process. That means a new standard of uniformity in chemical composition . . . with optimum, uniformly distributed, controlled phosphorus content. It means sound metal — smooth, dense, free from pits or porosity. Such important differences in this and other Scovill Tube Alloys can make all the difference in efficient, economical service under tough operating conditions.

You will also find equally important differences in Scovill's unrivaled Heat Exchanger Tube Technical Services. Ask us to prove it on your next new installation or re-tubing job. The Scovill Manufacturing Company, 99 Mill Street, Waterbury 20, Connecticut. Phone Waterbury 4-1171.

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Cushioned
Boiler Non-return Valves
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Steam Check Valves
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cation exchanger; Nalcite SAR, a strongly basic anion exchanger; and Super Nalcolite, a synthetic gel type zeolite for cation exchange. Tables and graphs explain performance of these water treating resins under various operating conditions. Physical characteristics, exchange capacities, regeneration techniques discussed. Bulletin 57, 20 pp, is on Nalcite SAR; Bulletin 58, 28 pp, Nalcite HCR; Bulletin 59, Super Nalcolite. National Aluminate Corp.

275 For Industrial Water Softening — Greensand, zeolite and resinous exchange water softeners are described in 8-pp Form S-105. Discusses features and applications of each of these basic types and illustrates some installations. Includes capacity data and general specifications. Also describes and pictures controls for water softeners, pressure filters and deionizers. Illinois Water Treatment Co.

Postage-free cards for ordering these catalogs are provided on pages 105-106. When using them, don't forget to include your job title and company name —even if you want your catalogs to be delivered to your home address

276 Corrosion Treatment — "Corrosion Protection of Steam and Condensate Return Systems" is a folder on amine treatment for boiler and condensate systems. This treatment is described as affording surface protection of the metal as well as raising pH value of condensate. The Bird-Archer Co.

278 Water Conditioning Bulletin — This is an 8-pp discussion of water and the chemicals developed for conditioning it to control scale and algae and inhibit corrosion. Describes several chemicals in detail, giving properties, composition. Wright Chemical Corp.

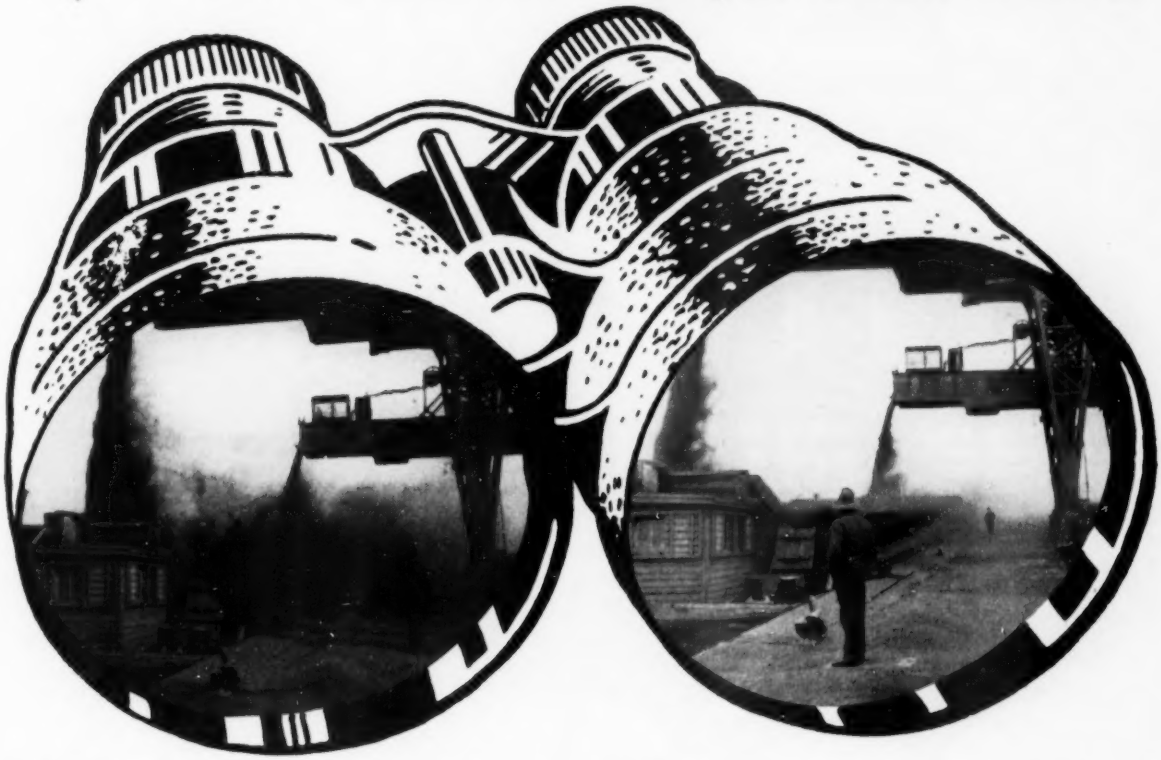
279 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pretreatment, internal treatment, treatment application, blow-down adjustment, test control. Dearborn Chemical Co.

280 Microbiological Control — Technical Article 3C, 12 pp, is an illustrated discussion of microbiological control of and through industrial waters. A section on industrial water chlorination covers cooling waters and process waters. Other sections deal with chlorine metering in chemical processes, and the sanitary aspects of industrial water treatment. Wallace & Tiernan Co., Inc.

INSTRUMENTS AND CONTROLS

281 Supervisory Instruments — Catalog 90-2, "Supervisory Instruments for Power Generation" consists of 41 pp on the instrumentation involved in generating stations. Separate sections cover steam generation instrumentation, turbine and generator instrumentation, electrical distribution instrumentation and diesel engine instrumentation. Measurement of temperature, pressure, flow, power generation are discussed. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

Look how this dock Stops Coal Dust



BEFORE—Barge loading of carbon size coal (¼" minus) at Eastern Railroad Coal Dock operating without the application of Johnson-March Compound "M". Note volume of dust.

AFTER—View of the same loading operation with a Johnson-March engineered system in operation. Note effective suppression of dust.

Here's how YOU can STOP COAL DUST!

A LOW COST Johnson-March engineered dust control system in operation in your plant enables you to eliminate the community dust nuisance and the threat of fires and dust explosions.

CONTROLLING COAL DUST in your power plant will "pay off" in reduced maintenance costs, and safer working conditions.

MANY LEADING POWER PLANTS now stop coal dust right at its source at car dumpers, hoppers, belt galleries, crushers and storage piles, with a Johnson-March System.

JOHNSON-MARCH ENGINEERED SYSTEMS cost only 1/10 that of mechanical systems, and maintenance cost is next to nothing. No bulky ducts, hoods or fans to interfere with normal operations.

IF YOU now have no control over coal dust . . . or if you want to improve the effectiveness of an existing mechanical dust collection system, talk over your requirements with Johnson-March engineers. Drop us a line today.

Johnson March

Dust Control Engineering

DEPT. PE-2, 1724 CHESTNUT STREET, PHILADELPHIA 3, PA.

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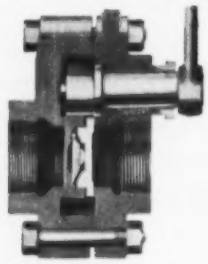
EVERLASTING VALVES

Mean "Everlasting" Protection on these duties

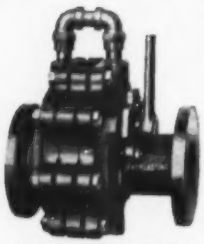
BOILER BLOW-OFF

Quick-opening, also hand-wheel operated. Angle and "Y" types and combination units meeting ASME Code requirements for pressures up to 600 psi.



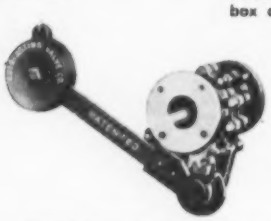
GENERAL SERVICE

Wherever frequent use and quick operation is required for any liquid or gas at pressures up to 300 psi. These valves have outside stuffing box and gland.



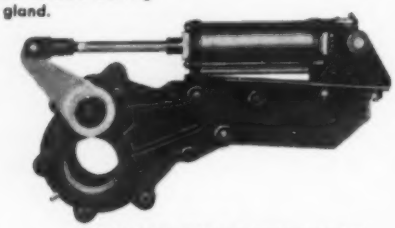
STEAM JACKETED

Assure continued free flow of any material which congeals at ordinary temperatures.



EMERGENCY PROTECTION

Closing type for inflammable liquid emergency shut-off, or opening type for deluge or drainage, assuring immediate and positive action with weighted pendulum stop.



CYLINDER-OPERATED VALVE

for accurate control of process work. Straight-through flow, drop-tight seal, air or hydraulic control for operation at any speed.

EVERLASTING FEATURES

For more than 40 years, EVERLASTING VALVES have been known for their ingenious design, simple, sturdy construction, and long trouble-free life with low maintenance expense. Some of their distinctive features are:

Quick-Action . . . Opened or closed with less than a quarter turn of the operating lever.

Straight-Through Flow . . . the disc cannot become loose and accidentally check the flow.

Drop-Tight Seal . . . constant contact of disc and seat at all times prevents dirt or scale from getting between.

Self Regrinding . . . the disc rotates on the seat with each operation, thus regrinding the sealing surfaces.

No Wedge Action . . . all parts move between parallel faces.

Write for bulletin describing* EVERLASTING VALVES *in detail.

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Everlasting Valves

TRADE MARK "EVERLASTING" REG U S PAT OFF EV-381

for everlasting protection

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282 Control Equipment — Catalog 003, 32 pp, presents company's equipment for the control of liquids and gases for water and sewage works, power and process industries. A well illustrated booklet, it lists many types of controllers, gages, manometers, valves, venturi tubes. Description of the units, their operating characteristics, construction details, mountings, specifications and other data included. Simplex Valve & Meter Co.

283 Metering and Control Equipment — Sixteen-pp Bulletin 18 is a comprehensive catalog offering information on company's meters, control equipment and engineering services. It is written for engineers in power plants, public utilities and process plants. Fifteen measured variables common to power and process operations form the index for selecting appropriate metering and control equipment. Basic specifications, and detailed literature references included. Bailey Meter Co.

284 Steam Specialties — Catalog 53, 62 pp, describes a line of steam, gas, air, oil and water regulating equipment. Includes complete specifications, operational data and prices on pressure regulators, temperature regulators, combination pressure-temperature, instruments, diaphragm valves, motor operated valves, float valves, safety and relief valves, strainers, solenoid and motor valves, water gages. Provides capacity tables, flange charts. O. C. Keckley Co.

285 Electronic Feedwater Control — Three systems for the electronic regulation of boiler feedwater are explained briefly and diagrammed in Bulletin 52-1073-221. They include a single-element, two-element, and three-element system. Applications for each type are told, and descriptions of the flow measuring, receiving, level measuring elements, power unit and valve are included. The Hays Corp.

286 Instruments, Controls — Condensed Catalog 1537 offers brief application information on manufacturer's line of instruments. Fully illustrated, covers draft and pressure instruments, flow meters, liquid levels and pressure gages, CO_2 meters, pneumatic transmitters, positioning operators, temperature instruments, boiler feedwater controls, others. Includes references to detailed literature on each type of equipment. Republic Flow Meters Co.

287 Easy Reading Gage — An all-hydrostatic remote reading gage for boiler water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered by this gage, explains operation. The Reliance Gauge Column Co.

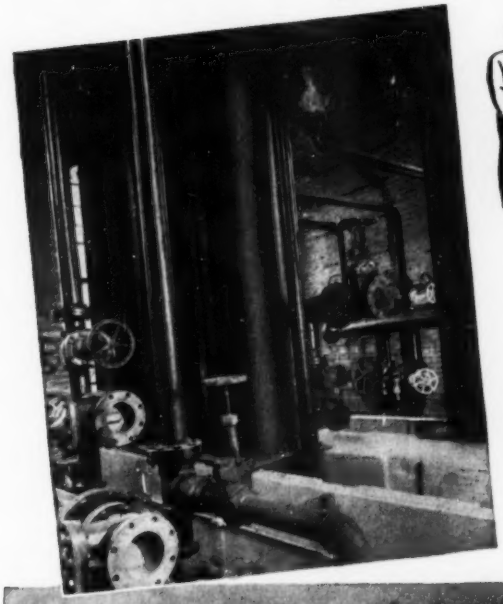
OTHER EQUIPMENT

288 Turbine Generators — Bulletin H-18, 40 pp, covers turbine generators of 500 kw and above, pictures nearly 50 turbine-generator installations, both utility and industrial. Brief discussions of generator and exciter cooling methods are included. A reference section offers detailed drawings. Elliott Co.

289 Motorized Chimney Draft — The advantages of mechanical draft in supplying positive, uniform, adequate draft, regardless of variable weather conditions or inadequate chimney or breeching construction are shown in detail in Bulletin I-52. Also discusses other advantages, including eliminating need for tall stacks. L. J. Wing Mfg. Co.

Dirty Water can't "Shut-down"...

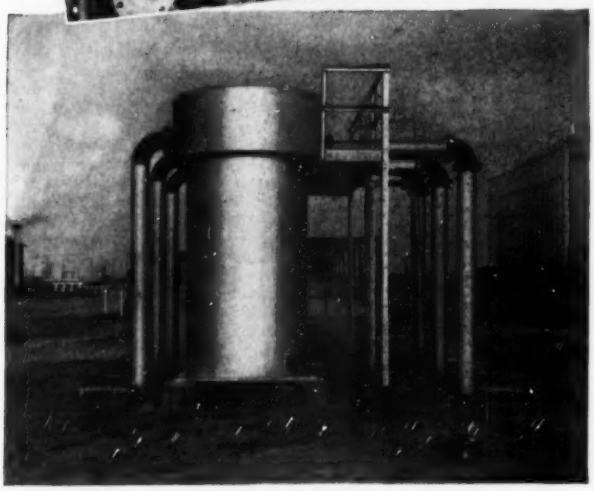
Vogt



film type exchangers

(Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424,441



River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any fluid.

TOP: *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler.*

BOTTOM: *Jacket Water Coolers serving engines of 7,300 HP in the compression plant of a Western Oil Refinery.*

[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request.]

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

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WORKS WELL *Under Pressure*

This True Ball Joint Makes the Difference

Dart malleable iron unions, sizes ⅛″ to 2″ are recommended for 300 lbs. working steam pressure; sizes 2½″ to 4″ for 250 lbs. working steam pressure at temperatures not over 500° F. Darts give a snug, drop-tight fit easily without excessive wrenching — and you can use them over and over again.

QUICK FACTS

- *Leakproof* because precision-machined to a true ball joint and spherically ground.
- Bronze alloy seats are extra wide, resist pitting and corrosion.
- Shoulders are heavy — can take rough treatment.
- Nut and Body are practically indestructible . . . of air-refined, high test malleable iron.

* Take the pressure off *yourself* — tell your supplier you want *Darts!*

DART

UNIONS

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The Fairbanks Co. — Distributors: Boston • New York • Pittsburgh • Rome, Ga.

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290 Dowtherm Vaporizer — Bulletin No. 48-2, describing manufacturer's Type "A" Dowtherm Vaporizer, tells how this unit is designed to evaporate Dowtherm to provide dependable operation at maximum temperatures. The Wickes Boiler Co.

291 Preheating Combustion Air — How to reduce fuel consumption as much as 30 per cent by preheating combustion air for process equipment is told in this 12-pp bulletin. Discusses advantages of increased production, improved product quality, and reduced maintenance. Includes tables of operating data, photos and diagrams of typical installations and a chart for determining fuel savings. Air Preheater Corp.

292 Ejector Instruction Manual — Bulletin J-50-7 is a 36-pp handbook covering operation, selection, installation and maintenance of steam jet air ejectors. Discusses twin and triple element ejectors, surface and jet inter- and after-condensers, isolating valves, drain traps, steam and back pressures. Foster Wheeler Corp.

293 Refrigerator Condensers — Bulletin RC-2, 38 pp, utilizes drawings, tables and engineering data to show how to select proper type from company's line of ammonia and Freon condensers for refrigeration services. Illustrates horizontal multipass shell and tube types; vertical singlepass shell and tube types. Gives pipe sizes for ammonia and Freon lines; stands for large and small condensers; condenser-tower with tables showing parts. Henry Vogt Machine Co.

294 Dry Ice Converters — This illustrated bulletin describes pressure vessels with removable closures into which dry ice is charged and in which the resulting carbon dioxide is stored indefinitely under pressure. Gives advantages of CO_2 for purging or use as an inert gas, and advantages of the dry ice converters as a source of CO_2. Includes installation suggestions. Dry Ice Converter Co.

295 Burning Bituminous Coal — This 24-pp illustrated booklet is a compilation of numerous actual case histories of industrial plants and institutions which burn bituminous coal "the modern way." Stressing operating economy achieved, these case histories show problems overcome, equipment used, and savings realized. Bituminous Coal Institute.

296 Refractories for Heat, Power — Compiled to help power engineers solve refractory problems and get greater operating efficiency from their boilers, this booklet provides 32 pp of practical information on company's Crystolon refractories. Properties and characteristics of these silicon carbide products are given and separate chapters cover those for air-cooled, solid wall and water tube protection, and for repairs. Norton Co.

297 Fluid Drive — Of value to power engineers interested in obtaining adjustable speed operation in a range from 100 to 2500 hp is 24-pp Bulletin 9319, illustrated in color. Covers company's Type VS, Class 4 Gyrol fluid drive, explaining its principle of operation and illustrating its use with forced and induced draft fans, centrifugal compressor and reciprocating pump. American Blower Corp.

298 Heat Exchanger — Bulletin 114, a small folder, gives concise information on company's Aero heat exchanger with bal-

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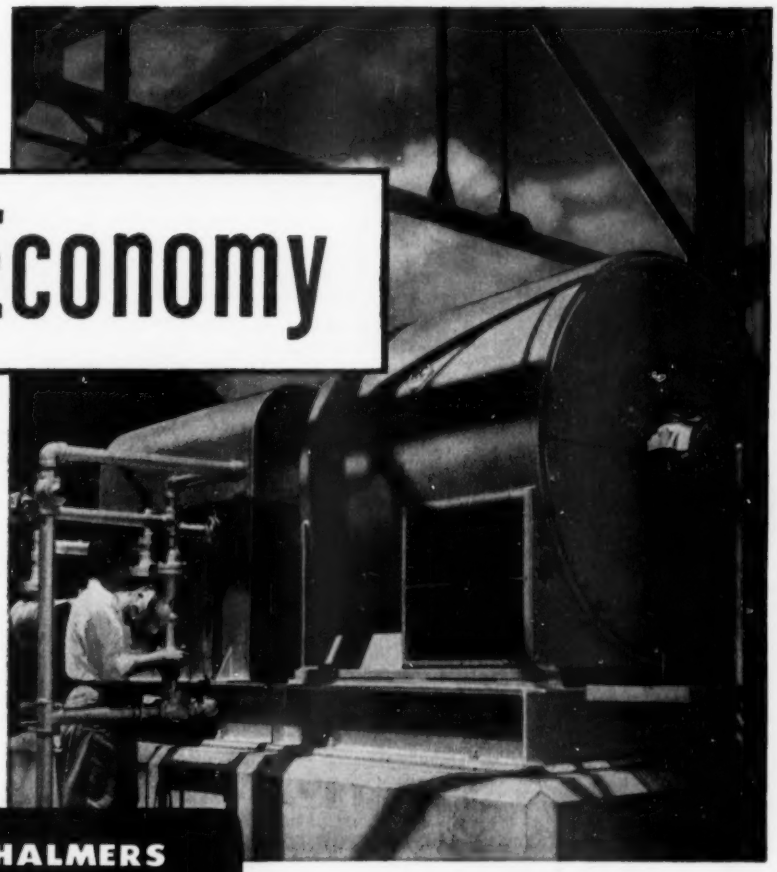

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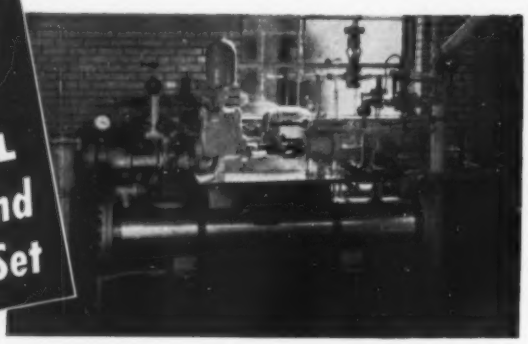

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anced wet bulb control designed to cool engines or process equipment, coolants and lubricants, liquids and gases for processing operations. Niagara Blower Co.

299 Water Heaters — Illustrated 6-pp Bulletin 70, Section I, on instantaneous type water heaters contains detailed capacity and dimension tables for two-, four- and six-pass designs, removable tube bundles. Davis Engineering Corp.

300 Communication Systems — Sixteen-pp Form P831 presents communication systems engineered for power plants. Advantages of such a system are given and photos show it in use in turbine rooms, boiler rooms, control rooms, laboratories and outdoors. Amplifiers, handsets, speakers, wall baffles, signal lights, switches and master control equipment incorporated are covered. RCA Victor Div., Radio Corp. of America.

301 Industrial Products Guide — Newest edition of this company's industrial products catalog is a 40-pp book offering essential data on insulations, refractory products, asbestos cement pipe, packings, gaskets, electrical products, frictional materials, and others. Photos, diagrams, and text have been brought up to date. Johns-Manville.

302 Automatic Soot Blowing — Bulletin 483 provides 16 pp of basic information about Vulcan automatic and automatic-sequential soot blowing. Includes a wide variety of typical installation drawings to show complete cleaning systems. Copes-Vulcan Div., Continental Foundry & Machine Co.

303 Sheet and Plate Fabrication — Illustrated in 40-pp Bulletin F-3 are products of this manufacturer, and equipment used to produce special sheet steel and alloy parts. Shows control panels, switch gear housings, cubicles and other electrical enclosures, boiler air ducts, smoke breechings, tanks. The Kirk & Blum Mfg. Co.

304 New Engine Developments — Bulletin S-500-B-55, 12 pp, presents new developments in oil diesel, dual fuel diesel and high compression spark ignition engines. Describes features of modern, economical, heavy duty, internal combustion engines. Includes a heat balance chart showing waste heat recoverable from exhaust gases and jacket cooling water; and is accompanied by fuel cost charts on installations utilizing heat recovery systems. Engine Div., Worthington Corp.

305 Refractory Concrete — This 28-pp booklet describes company's Lumnite, a calcium aluminate cement for refractory concrete. Discusses characteristics of Lumnite, methods of making refractory concrete. Chapters are devoted to summary of aggregates and proportions; heat-resistant concrete; refractory insulating concrete; insulating over-coats for industrial furnaces; castable refractories. Universal Atlas Cement Co.

306 Copper and Corrosion — Information on corrosive attack on copper and copper alloys is presented in Publication B-36R, a new 28-pp revised edition of company's booklet, "Corrosion Resistance of Copper and Copper Alloys." Explains chemical and physical nature of corrosive attack in its various forms, and provides a tabulation showing the relative corrosion resistance of the principal types of copper and copper base alloys in contact with corrosives. The American Brass Co.

How a hot problem in steel stacks was solved with refractory concrete

YOU'RE LOOKING UP one of the twin 215′ steel stacks lined with refractory concrete at Basic Refractories, Inc.'s plant in Maple Grove, Ohio, for dead-burning granular refractories Smooth, jointless construction and insulating properties provided excellent natural draft. Such refractory linings assure structural strength, plus high resistance to heat and corrosion.

REFRACTORY concrete linings in stacks, breechings and ducts provide protection against heat, corrosion and the abrasive action of high-velocity gases and fly ash. Made with suitable aggregate and Lumnite* calcium-aluminate cement, they withstand temperatures to 2600° F., and are highly resistant to thermal shock. Smooth, jointless construction allows excellent draft in stacks, breechings and ducts.

Stack linings are just one of the many ways special concretes made with Lumnite are serving industrial plants. They are readily poured, plastered or "shot" in place by cement gun. There are no small units to work loose; maintenance is lessened. When necessary, repairs can be made quickly, easily and economically. Refractory concrete made with Lumnite Cement reaches service strength within 24 hours.

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FOR CONVENIENCE, many prefer to make refractory concrete with prepared castables. (Lumnite Cement plus suitable aggregates selected for specific temperature and insulation service—add only water.) They're made by refractory manufacturers and sold through their dealers. For more information, write Universal Atlas Cement Company (United States Steel Corporation Subsidiary), 100 Park Avenue, New York 17, N. Y.

SPECIFIED TO MEET TOUGH DESIGN requirements, these stacks for large rotary kilns needed linings that could withstand 1400° to 1700° F. operating temperatures. Designers used an 8″-thick refractory concrete lining . . . poured in place.

*"LUMNITE" is the registered trade-mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.

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continued from page 68

especially against eels. The intake structure will have to be modified, new inlet piping installed as part of the No. 2 unit installation, and a new screen-well constructed within the station structure. Heat balance of the No. 2 unit is simple, as shown in Fig. 7.

The No. 2 generator will supply its power at 13,800 v through underground conduit to the existing outdoor sub-station on the far side of the diesel plant, Fig. 6. That sub-station was enlarged at the time steam Unit No. 1 was built, and will be enlarged again for No. 2. The main transformers in this sub-station raise voltage to 33,000 v for transmission over the company's "back bone" transmission system, which has been continuously enlarged during the past few years. However, the transmission line is designed for 69,000-v operation at some future time.

The diesel plant at Caribou was built in a hurry to meet an emergency caused by failure of water power in 1947. Starting then with a 1400-hp supercharged Nordberg engine, the plant has been enlarged so that it now includes five engines: two 3600-hp units, a 1400-hp unit, a 1440-hp unit and a 1500-hp unit. Fig. 2 shows three of these engines. Their power is fed to the adjacent sub-station in parallel with that of the steam plant.

The Caribou hydro plant, first of the group to be built, is at the end of the dam, Fig. 6, just downstream from the diesel plant. It contains two vertical water wheel generators of 500-kw capacity each. Hydroelectric generators at the Tinker plant, including a new 3500-kw unit, raise total hydro capacity of the system to 12,700-kw.

Operation and Maintenance

With the foregoing general description of the three Caribou plants in mind, some of the ways in which they are co-ordinated in operation should be obvious. Others are not so obvious.

The dam, owned by the power company, also contributes to the water system of the City of Caribou. The hydro plant supplies firm power to the diesel and steam plant auxiliaries. The diesel power will be especially valuable to supply forced draft fan power on the new pressurized furnace boiler when starting up. Steam plant Unit No. 1 goes on the line by itself and the diesel plant instruments show when the steam plant is on.

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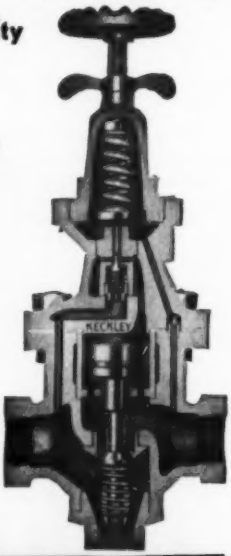

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Normal daytime load on the existing steam station has been about 9000-kw at unity power factor. Total generating capability, before the new steam turbine generator is installed, is 31,800 kw and the system peak reached 27,800 kw during Christmas week of 1952; 30,000 kw in 1953.

No Winter Problems

Although steam connections have been provided for oil unloading and oil tanks, no steam was required to heat the oil during the first winter of operation. Ice at the intake was only a minor problem, although some provision may be made for combating it in the future. In short, during the first winter, although outdoor temperatures occasionally reached −36 F, they caused no major troubles.

Advantages of the closely co-ordinated operation of the Caribou steam, diesel and hydro plants are numerous. There is a common railroad siding off the main line of the Bangor & Aroostook Railroad for unloading both Bunker C and diesel oil. The "tank farm" is now well integrated. There are common fire alarm and intercommunication systems for the three plants. Common pickup trucks and a common warehouse aid convenient storage and delivery of spare parts. Tools and maintenance equipment can be used conveniently in all three plants.

Besides rail and truck transportation, there is an air field nearby and an official sea plane base right in the Aroostook River.

One Maintenance Crew

The hydro plant has supervisory control from the diesel plant and requires only one attendant. The diesel and steam plants each have their own operating crews, but there is a common maintenance crew for all three plants.

The diesel plant has a swing shift. The diesel operators do such jobs as cleaning filters but the maintenance crew does such work as replacing liners and the like.

In the steam plant, the operator's swing shift does some maintenance work, the maintenance crew the remainder, depending on conditions.

On the whole, this integrated operation of these three plants — steam, diesel and hydro — permits many tangible and intangible economies. The operating personnel, all local men, have high morale and, individually and collectively, enjoy high repute for good citizenship in their relatively small community.

James E. Little is superintendent of the Caribou Steam Plant; Myron Mosher is superintendent of the Diesel Plant. Their cooperation in preparing this article, also the assistance of Edward H. Barry, is deeply appreciated. Stone & Webster Engineering Corp. was responsible for design of the steam station and for general technical consultation for the company, whose president is L. H. Alline.

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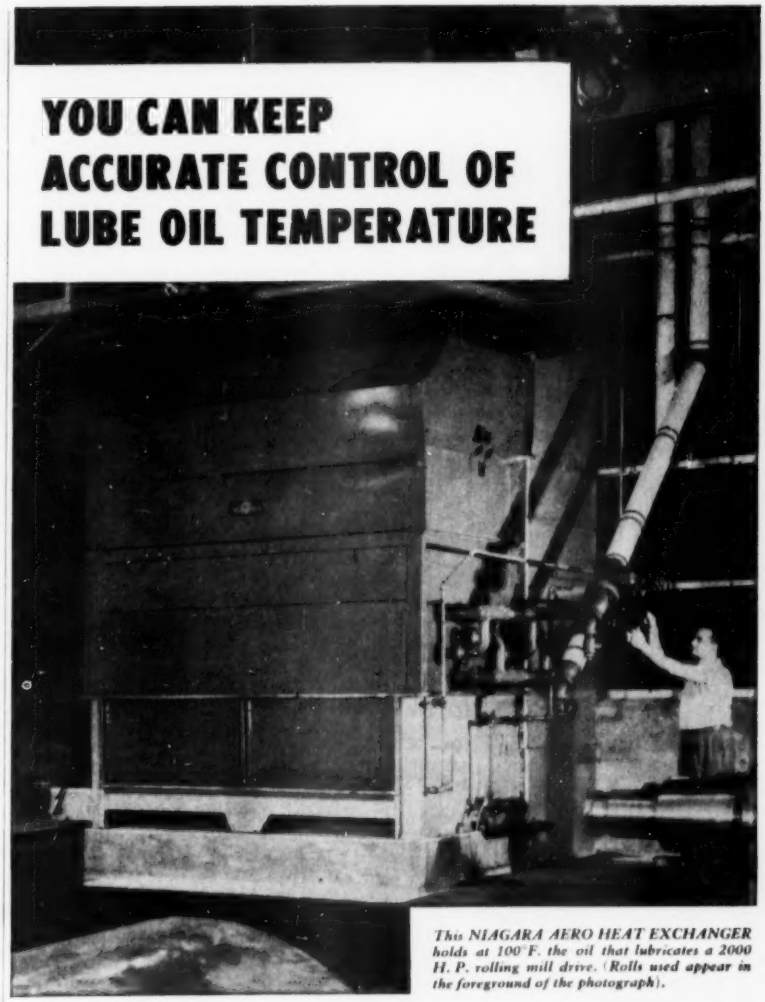

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Depreciation Rates Under New Tax Law

ONE PHASE of the new Federal tax program has already been agreed upon in the Ways and Means Committee and it is a fairly good bet that the following provisions will be included in the 1954 Revenue Act: Depreciation is to be allowed at double the present rate, applied on the declining balance (amortization) method. However, this provision will be available only on property acquired on or after January 1, 1954.

It works this way: You buy machinery with a 10-year useful life. It costs $10,000. Under the present law, using straight-line depreciation, your depreciation rate is 10 per cent for $1000 per year. The proposed law would allow 20 per cent depreciation and a write-off of $2000 in the first year. The remaining $8000 is also depreciated at 20 per cent for a $1600 write-off for the second year. At the end of 5 years, two-thirds of the cost will be depreciated.

How does this benefit a company?

Purchase of equipment or buildings is a capital expenditure which cannot be deducted from the current year's operating income for income tax purposes. Such property must be written off on a depreciation basis over the full life of the equipment. For that reason, the purchase of $10,000 in new equipment requires that approximately $20,000 in profits must be earned *before* taxes in order to have the cash to pay for that equipment *after* taxes.

This program should provide an incentive for companies to: (a) sell depreciable properties they now own and buy new equipment, (b) junk fully depreciated equipment and replace with new equipment, (c) purchase outright equipment previously rented.

Under item (a), accountants seem to feel that it will now be more advantageous to sell depreciable properties than to turn them in on new equipment. Selling the old equipment enables the company to take capital gains rates on the selling price rather than the equipment's undepreciated balance. On a trade-in, the undepreciated balance is deducted from the value of the new equipment, thereby reducing the amount of depreciation which can be charged off on the new equipment. Under item (b), junking of fully depreciated equipment is recommended. Otherwise, capital gains tax will be applied on whatever income is received on the sale.

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NEW ENGINEERING BOOKS

Introduction to Engineering Economy, by B. M. Woods and E. P. DeGarmo. Size 8½ by 5¾ in.; 519 pages including index. Published by the Macmillan Company, 60 Fifth Avenue, New York 11, N. Y. Price. $6.00.

In addition to having responsibilities of a technical nature, the engineer of today is confronted with problems demanding a knowledge of finance and economy. For those whose know-how on these subjects is limited, here is a helpful book. Although specifically written for the undergraduate student, it contains much information that comes in handy for the practicing engineer.

The introduction to the book considers such topics as capital requirements of industry, the engineer's relation to industry; and importance of human factors. The book goes on to cover, among other topics, the selection of materials, methods and design. Interest, annuities, stocks, bonds, formulas for calculating interest and depreciations are also given attention.

Some of the main sections of the book are as follows: financing engineering enterprises; fixed, differential and sunk costs; replacement; the use of graphical methods of analysis; life expectancy of physical property; and the relationship of accounting to economy studies.

Electrical Refresher for Professional Engineers License — by John D. Constance. New 2nd Edition — Revised; 100 pp; size 8½ x 11 in., paper. Privately published by John D. Constance, 625 Hudson Terrace, Cliffside Park, N. J. Price $3.00.

This is a revised edition of Mr. Constance's well known book which has already been widely used by those studying at home for their Professional Engineers' License Examinations. Though its main value is as a home study instrument for examination study, it has also proved very helpful as a reference manual in the examination room and as an office reference manual.

It can be widely used with profit by those studying for Examinations for Professional Engineer, Civil Service Examinations for Engineer, Junior Engineer, and Assistant Engineer, and for Power Engineer Examinations.

Most of the book is taken up with worked examples from actual Professional Engineer examinations. The license candidate is given an opportunity to work out a large selection of examples from past examinations.

The problem index has been rearranged and includes references both to the problems in the text and in the sections devoted only to problems.

The main value of the book is that it collects together the material the student needs to know just for these particular examinations, and so saves him the time and trouble of wading through large numbers of text books to find the comparatively small amount of material he needs for his particular exam.

Both the a-c and d-c sections of the book cover their subjects very thoroughly, and each problem is worked out completely and is clearly explained. There are few better ways of preparing for this type of examination than by working out past examination problems, and we recommend this book to everyone who is faced with the task of getting his Professional Engineer's License when it is a long time since he was last in an examination room and when he has forgotten most of the theory he once knew.

* * *

Handbook of Electronic Circuits — 8½ x 11 in., 123 pages, paper covered. Published by RCA Service Company, Camden, N. J., Government Service Division. Price single copies $1.60. Special price for training requirements 10 or more copies — $1.45 per copy.

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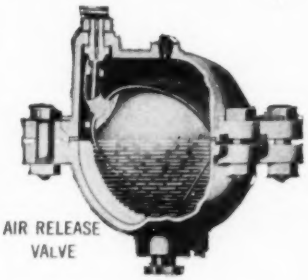

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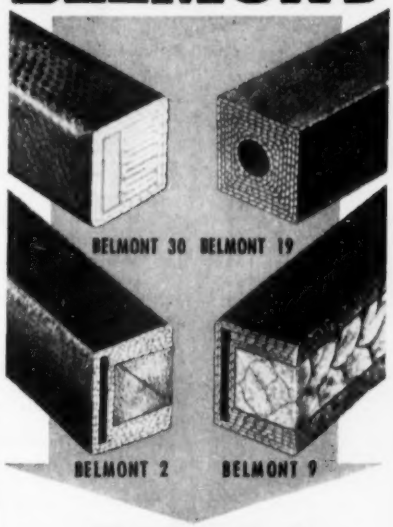

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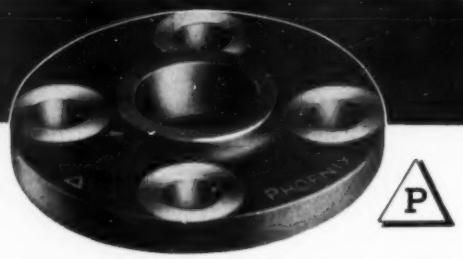

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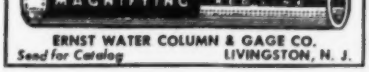

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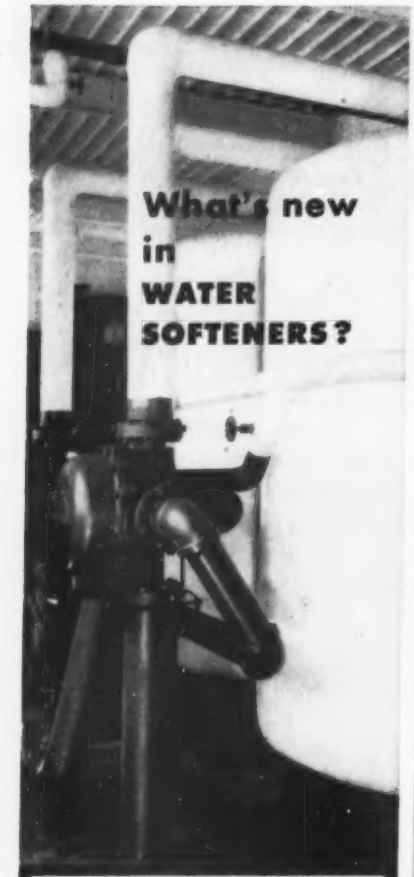

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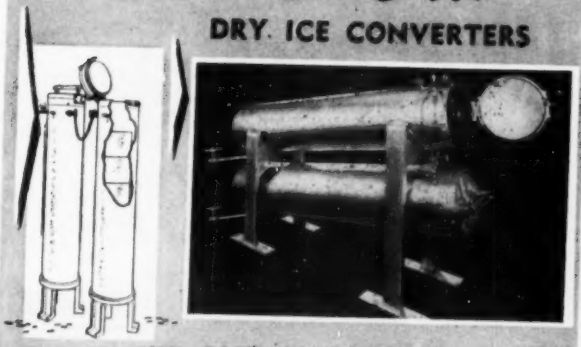

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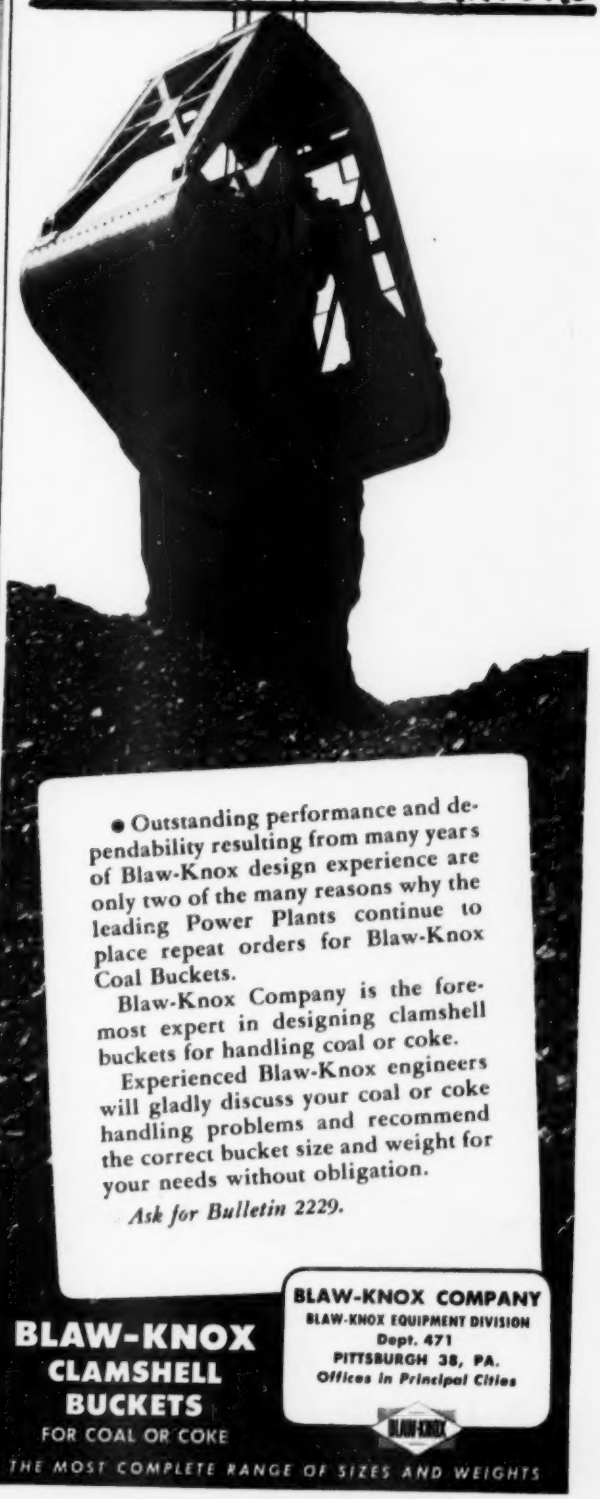

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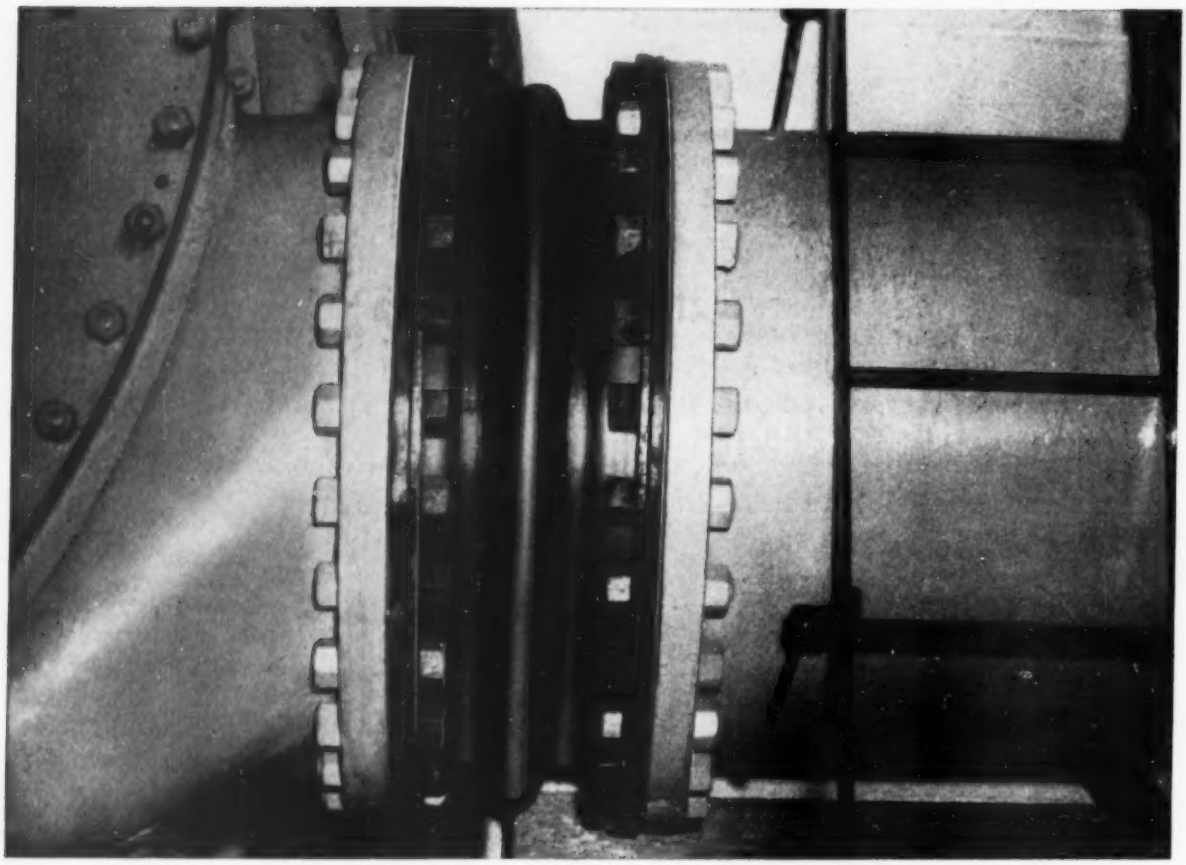

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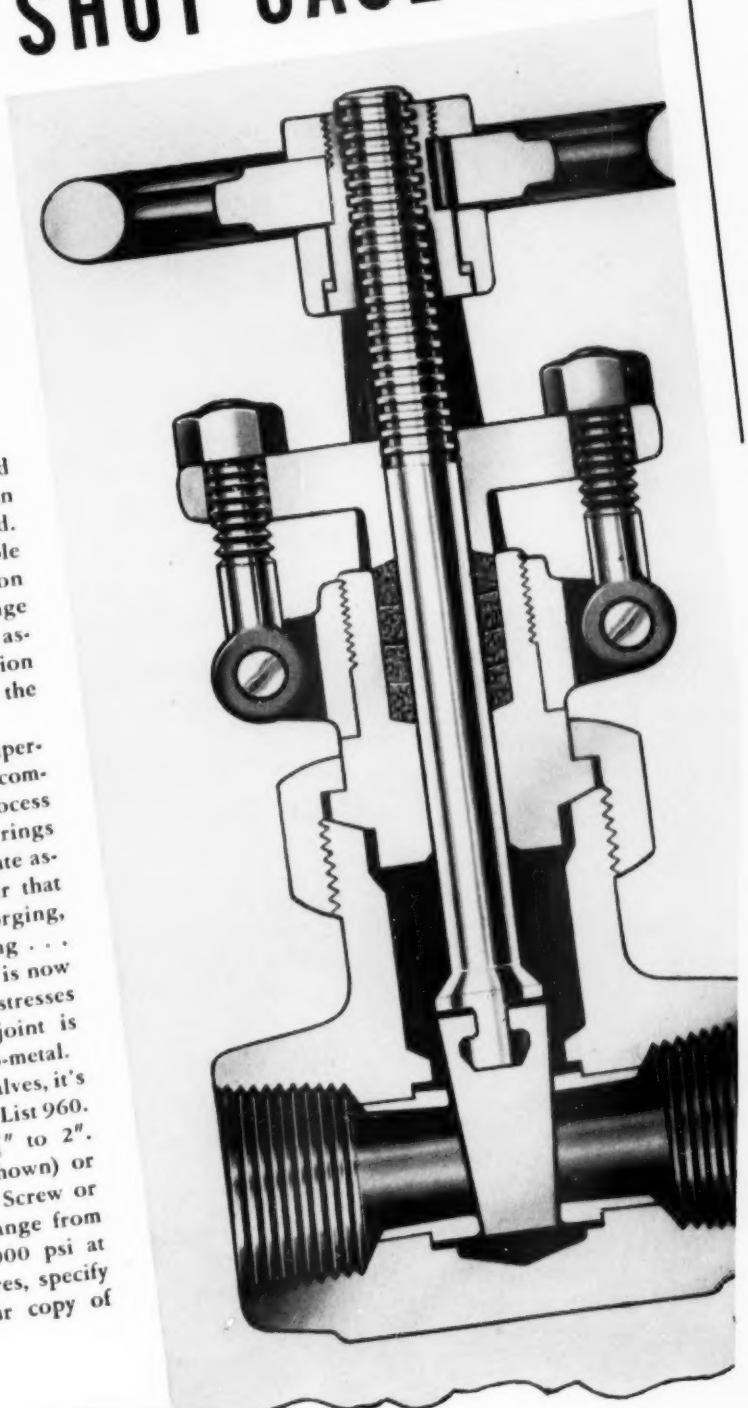

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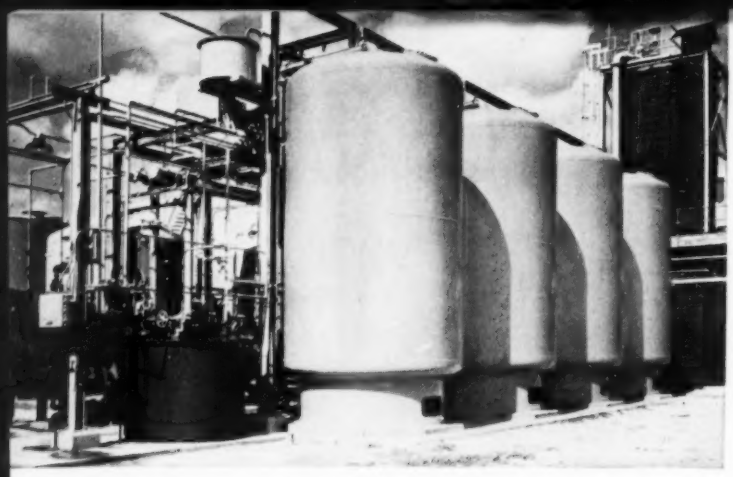

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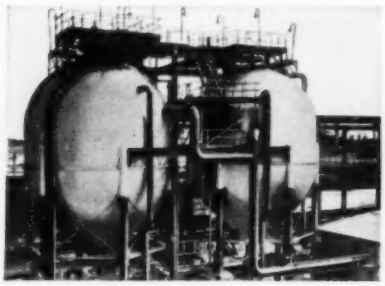

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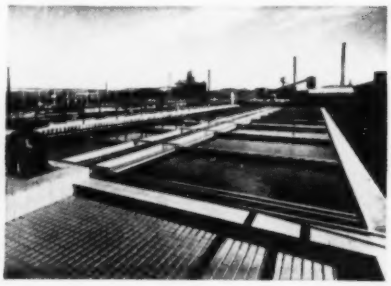

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